FLORA MALESIANA

SERIES I – SPERMATOPHYTA

Flowering Plants

Volume 12, part 1

Meliaceae

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FLORA MALESIANA

SERIES I — SPERMATOPHYTA

Volume 12 – part 1 – 1995

Meliaceae

by

D.J. Mabberley, C.M. Pannell, A.M. Sing

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SERIES I — SPERMATOPHYTA

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MELIACEAE

(D.J. Mabberley, C.M. Pannell (*Aglaia*) & A.M. Sing,
Oxford University Herbaria, United Kingdom)[1]

Meliaceae Juss., Gen. Pl. (1789) 263 ('*Meliae*'); T.D. Penn. & Styles, Blumea 22 (1975) 419–540; Mabb. in Fl. Nouv.-Caléd. et Dép. 15 (1988) 17–89; Mabb. & Pannell in Tree Fl. Malaya 4 (1989) 199–260.
Cedrelaceae R.Br. in Flinders, Voy. Terra Austr. 2, App. (1814) 64 ('*Cedreleae*').
Azedarachaceae Schultes in Roem. & Schultes, Syst. Veg. 5 (1819) xxxviii ('familia *Azedaracharum*').
Aitoniaceae (Harv.) Harv., Fl. Cap. 1 (1860) 243 ('*Aitonieae*').

Trees, treelets, often pachycaul or, more rarely, shrubs or suckering shrublets, monopodial or sympodial, rarely with *Terminalia*-branching (*Vavaea*), dioecious, polygamous, monoecious or with all flowers hermaphrodite. *Indumentum* of simple, bifid or stellate hairs or stellate or peltate scales or sometimes mixtures of these, sometimes with small glands. *Buds* naked or with scale-leaves (in Malesia only in subfam. *Swietenioideae*). *Leaves* exstipulate (occasionally pseudostipules present), spirally arranged, rarely decussate, pinnate (sometimes with a terminal 'bud', i.e. pseudogemmula), trifoliolate, with a single blade (simple or unifoliolate) or rarely bipinnate (*Melia*); rachis very rarely winged; leaflets usually entire, rarely lobed or serrate (or spinous, not in Malesia), sometimes with minute black glandular dots. *Inflorescences* thyrsoid, racemose or spicate, sometimes reduced to fascicles or solitary flowers, axillary, supra-axillary, ramiflorous, cauliflorous to groundlevel or rarely epiphyllous (*Chisocheton*). *Flowers*[2] hermaphrodite and/or more usually, unisexual, with well developed rudiments of opposite sex. *Calyx* usually ± lobed, sometimes with discrete sepals, these occasionally spirally arranged and transitional to bracteoles (*Dysoxylum*), sometimes truncate or closed in bud and circumscissile at base at anthesis. *Petals* 3–7(–14), in 1 whorl, rarely (some *Chisocheton* species) in a spiral to give up to 2 (apparent) whorls, green, white, cream, pink to claret and violet or yellow (*Aglaia*). *Stamens* usually partially or completely united by a tube with or without lobes; anthers 3–10(–30) in 1 or, rarely, 2 or more whorls, sometimes locellate, at tips of filaments or at the margin of the tube or within its throat. *Disk* (at least sometimes nectariferous) around ovary, cushion-like, tubular or absent. *Ovary* (1–)2–6(–20)-locular, each locule with 1–many ovules; stylehead discoid to capitate. *Fruit* a capsule, berry or drupe. *Seed* with fleshy aril or sarcotesta or a combination of these or winged and then attached to a woody columella, or with corky outer layers, or very rarely without any of them, endosperm usually absent; cotyledons

1) With contributions by P. Baas, Leiden (vegetative anatomy), T.P. Clark, Oxford (*Pseudoclausena*, *Walsura*), J.M. Edmonds, Oxford (*Toona*), R.W.J.M. van der Ham, Leiden (palynology), R. Hegnauer, Leiden (phytochemistry). The drawings are by Ms. Rosemary Wise at Oxford and Ms. Ruth van Crevel at Leiden. The photographs are from various sources, as indicated.

2) As it seems that male flowers may fall before females or hermaphrodites, it is often difficult in the absence of field studies to ascertain the true sexual arrangements of any particular species. Sizes of floral parts throughout the text are those of dried material, which sizes are often less than half those of fresh material.

collateral, superposed or, rarely, oblique, emergent or not at germination, when scale leaves are sometimes produced before first foliage leaves, which may be opposite or spirally arranged, simple or pinnate with later ones simple to bipinnate. 2n = 16–c. 360.

INTRODUCTORY NOTE

The bulk of this text was prepared by D. J. M. in 1982/83 at Leiden and, in consequence, largely follows the original style of Flora Malesiana. As there are no modern monographs of several of the genera, the text therefore provides the only available guide to those concerned with *Meliaceae* in these genera beyond the Flora Malesiana area. For that reason non-Malesian synonyms and references have been included.

DISTRIBUTION

Throughout the Tropics and Subtropics, with weak penetration into temperate zones, the family comprises 50–52 genera with about 550 species.

Since Pennington & Styles's generic monograph (1975), *Megaphyllaea* Hemsl. is considered to belong in *Chisocheton* Blume and *Pseudocarapa* Hemsl. in *Dysoxylum* Blume, while *Heynea* Roxb. ex Sims is considered distinct from *Trichilia* L. and *Pseudoclausena* T. P. Clark has been segregated from *Walsura* Roxb.; *Turraea breviflora* may represent an undescribed genus and *Naregamia* Wight & Arn. may not be generically distinct from *Turraea* L., nor may *Pseudobersama* Verdc. from *Trichilia* L.

The family is best represented in the Malesian region for, although Africa is almost as diversified in terms of the number of genera, the Malay Peninsula alone has more species (91 in 17 genera) than the whole of Africa (84 species) and, furthermore, begins to approach the specific richness of the whole neotropical region (122), where only eight genera are found, so that the Malesian region is over twice as rich in genera and almost as much so in species as the Neotropics. The largest genus, *Aglaia*, is centred on Malesia, the great bulk of the rest of the species being in the closely interrelated genera *Dysoxylum* and *Chisocheton*.

FOSSILS

Fossils with features which, if they were found in a living plant, would place them in the concept of the modern *Meliaceae* are known from the Upper Cretaceous, some of the earliest ones being referred to the genus *Guarea*. Those referred to *Cedrela* are recorded from the Palaeocene (Raven & Axelrod 1974) and Pliocene (Graham 1991), the closely allied Indomalesian *Toona* is from the Eocene (London Clay) of England and those referred to the African *Entandrophragma* C. DC. are recorded from the Miocene of Kenya (Chesters 1957). The volcanic basalt deposits of the Cretaceous/Tertiary boundary, the Deccan Intertrappean beds of Mandla District, have yielded fossils referred to *Aglaioxylon* and *Heyneoxylon*, allied to *Aglaia* and *Heynea* respectively (Trivedi & Kiran Srivastava 1982), while '*Carapa* spp.' (i.e. *Xylocarpus* spp.?) are known from the so-called peat bed near Calcutta, 22° 08' N (Ghosh & Negi 1958). See also Miller (1990).

References: Chesters, K.I.M., Paleontographica B 101 (1957) 30–71. — Ghosh, S.S. & B.S. Negi, Curr. Sci. 27 (1958) 359–360. — Graham, A., Ann. Missouri Bot. Gard. 78 (1991) 201. — Miller, N.G., J. Arnold Arbor. 71 (1990) 453–486. — Raven, P.H. & D.I. Axelrod, Ann. Missouri Bot. Gard. 61 (1974) 587. — Trivedi, B.S. & Kiran Srivastava in Nautiyal (ed.), Phyton. Studies on living and fossil plants. Pant Commem. Vol. (1982) 255.

HABITAT

Meliaceae are very common trees of the canopy and understorey of lowland primary forest throughout Malesia, making up between 2.3% (Van Steenis 1984) and 17% of all trees over 10 cm bole diameter (Whitten et al. 1984) in the forests of Sumatra for example. They are absent from only the driest zones, though in Australia, for example, they are found even there, as species of *Owenia* F.Muell. They are represented by species of *Xylocarpus* on rocky shores and in mangrove swamps, into the upper reaches of which penetrates *Aglaia cuculata*. They are poorly represented at higher altitudes although some *Dysoxylum* species and *Toona sinensis* are sometimes conspicuous in lower montane forest. The family is represented in freshwater swamp forest by *Sandoricum borneense* and *Chisocheton amabilis* and includes some species restricted to limestone, like *Chisocheton ruber* of Sarawak, while *Walsura monophylla* is restricted to ultramafics. Along rivers in west Malesia are a number of rheophytic species of *Aglaia* and *Dysoxylum angustifolium* while *Aglaia cucullata* is believed to be found along tidal riverbanks. *Sandoricum borneense* seems always to grow along riverbanks too. A few species are tolerant of more open conditions and will colonize large gaps in forest or are frequently encountered in secondary forest e.g. *Aglaia argentea*, *Chisocheton tomentosus*, *Toona* spp. and *Chukrasia tabularis*, which even colonizes bare ground along road cuttings in the Malay Peninsula.

In Africa, the commercially significant swietenioid *Meliaceae* are emergent trees, some of the biggest in the continent and, in Java, 58-metre tall specimens of the melioid *Dysoxylum mollissimum* were some of the island's tallest trees, but these have long been removed, like the commercial mahoganies of South America, now severely depleted, and the red cedar, *Toona ciliata*, in northeastern Australia.

References: Steenis, C.G.G.J. van, Blumea 29 (1984) 405. — Whitten, A.J., et al., The ecology of Sumatra (1984) 262.

POLLINATION

Most species appear to be insect-pollinated, the agents possibly being bees, stingless sweatbees or syrphids in those cases examined (*Aglaia* spp., *Xylocarpus* spp.), while some species are strongly scented particularly in the evening, which, with their white flowers, suggests moth pollination in e.g. *Chisocheton* and *Dysoxylum* spp. as recorded in neotropical *Cedrela* and *Guarea* spp. Some species of these two Old World genera have long flagelliform inflorescences suggesting bat pollination, though the Bornean species are known to be visited by spiderhunters; whether these birds are efficacious pollinators is not known.

DISPERSAL

The fruits of species of *Swietenioideae* are dry dehiscent capsules, the winged seeds of *Toona* and *Chukrasia* being wind-dispersed, the irregular corky-coated ones of *Xylocarpus* being dispersed by saltwater in which they float just below the surface. The indehiscent fleshy fruits of *Azadirachta indica* are known to be dispersed by bats and baboons in Africa, those of *Melia azedarach* by birds.

Those species of *Aglaia*, *Chisocheton*, *Dysoxylum* (see Whittaker & Turner 1994) and *Aphanamixis* with dehiscent capsules and arillate or otherwise fleshy seeds are known to be taken by birds, apparently attracted by the contrasting colours of seeds and/or pericarp, while those species with indehiscent fruits are, at least in *Aglaia* and *Reinwardtiodendron*, eaten by primates which pass the seed divested of its fleshy layers (Pannell & Kozioł 1987). The bird and primate 'syndromes' are associated in a sample of *Aglaia* spp. at least, with characteristic chemistry as might be expected, those taken by birds being high in lipid, those by primates higher in free carbohydrates, but it is clear that few if any tree species is restricted to any one species, or indeed group, of vertebrate dispersers. Moreover, as there are no native primates in some parts of the ranges of certain species, *Aglaia elaeagnoidea* in New Caledonia for example, it must be concluded that bats or birds are active dispersal-agents even for those species which are thought to be dispersed by primates or other terrestrial mammals elsewhere. The seeds of many species are taken by squirrels but whether these animals do more than harm is unknown. For further details on *Aglaia*, see below. A parallel to the situation within *Aglaia* appears to be bird-dispersed *Heynea* and the closely allied but mammal-dispersed *Walsura* (Clark & Mabberley 1991). In New Guinea, birds of paradise are the only known dispersal agents for *Chisocheton lasiocarpus* ('*C. weinlandii*') seeds (Beehler 1983).

Seeds of *Dysoxylum angustifolium*, and possibly *Sandoricum borneense*, are believed to be dispersed by fish like those of the neotropical *Guarea guidonia* (L.) Sleumer (Pennington 1981). This 'syndrome' has yet to be analysed chemically.

References: Beehler, B., Auk 100 (1983) 1. — Clark, T.P. & D.J. Mabberley, Nat. Monsp., h.s. (1991) 582. — Pannell, C.M. & M.J. Kozioł, Phil. Trans. Roy. Soc. Lond. B 316 (1987) 303–333. — Pennington, T.D. in Fl. Neotrop., Monogr. 28 (1981) 11 [*Swietenioideae* by B.T. Styles]. — Whittaker, R.J. & B.D. Turner, J. Trop. Ecol. 10 (1994) 167–181.

MORPHOLOGY AND ANATOMY

Growth form — In terms of 'architecture', most *Meliaceae* correspond to the Models of Corner (unbranched, inflorescences lateral) and related structures with this pattern variously reiterated (Model of Champagnat) in the scheme of Hallé & Oldeman (1970), from pachycaul to leptocaul, while the genus *Vavaea* has *Terminalia*-branching (Model of Aubréville) and the *Xylocarpus* architecture corresponds to the Model of Rauh (Tomlinson 1986).

References: Hallé, F. & R.A.A. Oldeman, Essai sur l'architecture ... (1970). — Tomlinson, P.B., The botany of mangroves (1986).

Vegetative anatomy (P. Baas) — *Leaf anatomy:* Metcalfe & Chalk (1950) provide a summary of the leaf anatomical range of the family based on the older literature. There are only very few more recent studies on the leaf anatomy of genera of *Meliaceae* which are also represented in Malesia (e.g., Farooqui 1981; Inamdar et al. 1986; Lersten & Pohl 1984). The indumentum includes simple unicellular hairs, two-armed hairs, stellate hairs, peltate scales, and variously shaped glandular hairs. Mucilage cells occur in the epidermis of *Chukrasia* and some other genera. Stomata are confined to the lower leaf surface and are usually anomocytic. Adaxial hypodermis is recorded in *Aglaia* and *Sandoricum*. Mesophyll is dorsiventral. Vascular system of petiole and midrib is diverse, present as a single arc or closed cylinder, with or without medullary bundles. Secretory cells of various shapes and sizes occur in the mesophyll of many taxa. Crystals are common, both solitary prismatic and clustered. A more comprehensive survey of the leaf anatomy of the *Meliaceae* is needed to assess its diagnostic and systematic significance.

Wood anatomy: The wood anatomy of the *Meliaceae* is well documented. Key publications are Moll & Janssonius (1908), Kribs (1930), Desch (1951), Metcalfe & Chalk (1950), Pennington & Styles (1975), and Ilic (1991). For a full annotated bibliography of the wood anatomy of the *Meliaceae* see Gregory (1994). The following concise description of the woods of the Malesian genera is largely derived from these key publications.

Growth rings ranging from absent to distinct, and, if present, usually marked by marginal parenchyma bands. Vessels mostly diffuse, but wood semi-ring-porous or ring-porous in *Melia*. Vessels of medium diameter to wide (maximum tangential diameter ranging from 80–320 µm) and occurring in low frequency (2–20/sq.mm). Intervessel pits nonvestured, alternate, small (2–4 µm) to medium-sized (4–8 µm), vessel-ray and vessel-parenchyma pits usually similar but half-bordered. Helical vessel wall thickenings recorded in narrow vessels of *Melia* and *Azadirachta*. Tyloses absent. Dark-coloured vessel contents (gum) often present. Ground tissue of either non-septate or septate fibres with minutely bordered to simple pits mainly confined to the radial walls (libriform fibres), thin- to thick-walled (thick-walled in e.g. the heavy timbers of *Dysoxylum*, and *Reinwardtiodendron*). Parenchyma mainly paratracheal: vasicentric, aliform, confluent and/or banded, in various combinations. Apotracheal parenchyma absent or present as marginal (zonate) bands and/or diffuse strands. Rays narrow (1–2[–3]-seriate) in many genera of the *Melioideae*, but broader in *Aglaia* p.p., *Azadirachta*, *Chisocheton* p.p., *Melia, Trichilia* p.p., *Sandoricum*, and *Walsura*; rays in the *Swietenioideae* 3–6- (1–7-) seriate. Ray composition often varying from weakly heterocellular (Kribs Heterogeneous III) to homocellular within individual genera. Crystals mainly in axial (often chambered) parenchyma in the *Melioideae*; restricted to marginal ray cells in most *Swietenioideae*. Silica bodies recorded in *Aphanamixis* p.p., *Azadirachta*, *Chisocheton*, *Dysoxylum* p.p., and *Trichilia* p.p. Traumatic gum ducts forming tangential bands occasionally present, e.g. in *Azadirachta, Dysoxylum, Melia*, and *Sandoricum*. Rays and axial parenchyma storied in a few genera, e.g. *Chukrasia* and *Xylocarpus*.

Pennington & Styles (1975) critically discussed the taxonomic value of the wood anatomical diversity in the *Meliaceae* and concluded that the secondary xylem provides

good characters for subfamily delimitation, and that the association of non-septate fibres with terminal parenchyma bands helps to characterize the tribes *Turraeeae, Melieae, Trichilieae* (except *Cipadessa*) and *Sandoriceae*, whilst septate fibres in combination with absence or sporadic occurrence of marginal parenchyma characterize the remaining tribes. Many individual genera and species overlap in their wood anatomical range, so that only few genera can be distinguished by their wood anatomy alone.

References: Desch, H.E., Manual of Malayan timbers Vol. 1, Malayan For. Rec. 15 (1951). — Farooqui, P., Indian For. 107 (1981) 237–242 (epidermis of *Azadirachta*). — Gregory, M., Bibliography of systematic wood anatomy of Dicotyledons, IAWA J. Suppl. 1 (1994), IAWA/Rijksherbarium/Hortus Botanicus, Leiden. — Ilic, J., CSIRO Atlas of hardwoods, Crawford House & CSIRO, Melbourne (1991). — Inamdar, J. A., R. B. Subramaniam & J. S. S. Mohan, Ann. Bot. 58 (1986) 425–429 (resin glands in *Azadirachta*). — Kribs, D. A., Amer. J. Bot. 17 (1930) 724–738 (wood anatomy). — Lersten, N. R. & R.W. Pohl, Ann. Bot. 56 (1984) 363–366 (extrafloral nectaries in *Cipadessa*). — Metcalfe, C. R. & L. Chalk, Anatomy of the Dicotyledons 1 (1950). — Moll, J.W. & H. J. Janssonius, Mikrographie des Holzes der auf Java vorkommenden Baumarten, vol. 2 (1908) 110–215. — Pennington, T. D. & B. T. Styles, Blumea 22 (1975) 419–540 (wood anatomy and classification).

Palynology (R.W.J.M. van der Ham) — Comparative accounts of the pollen morphology of the *Meliaceae* include those of Erdtman (1952; 18 genera), Chang & Wang (1956; 14 genera from China), Pennington & Styles (1975; 50 genera), Oltmann (1975; 12 genera from Madagascar) and Durdana Yunus & Nair (1989; 14 genera from India). That of Erdtman is very brief and hardly illustrated. Pennington & Styles offer short descriptions of nearly all genera, but they do no give any illustration or documentation of the extensive material studied. Durdana Yunus & Nair (l.c.), Straka & Friedrich (1984; 5 genera from Madagascar), El Ghazali (1993; *Khaya, Pseudocedrela, Trichilia*), Tissot et al. (1994; *Aphanamixis, Trichilia, Walsura*), and Bonnefille & Riollet (1980; *Trichilia*) provide the only scanning electron micrographs available to date.

The *Meliaceae* are a stenopalynous family. The pollen grains are nearly always isopolar, radially symmetric, suboblate to subprolate monads. Rarely the grains are oblate or prolate, and very rarely the pollen is shed in rhomboidal tetrads (*Dysoxylum championii* Hook. f. & Thoms. ex Thw., Sri Lanka, and allies). The equatorial outline is ± circular to obtusely angular. The polar axis (P) is 13–62 µm (mostly 25–40 µm), the equatorial diameter (E) is 10–77 µm (mostly 20–40 µm). Pennington & Styles (l.c.) recorded much higher values for the average overall grain size (10–130 µm; in many genera > 40 µm). Relatively small pollen grains (P usually < 30 µm) occur in the tribe *Aglaieae* (e.g. *Aglaia*, *Aphanamixis*, *Lansium*, *Reinwardtiodendron*). The tribes *Turraeeae* (e.g. *Munronia*, *Turraea*), *Melieae* (e.g. *Azadirachta*, *Melia*) and *Vavaeeae* (*Vavaea*) show relatively large pollen (P > 40 µm).

The aperture system is tri-, tetra-, or pentacolporate, the tetra-aperturate condition being most common. Pollen of the tribes *Turraeeae* (except *Munronia*) and *Vavaeeae* is usually tricolporate. The ectoapertures are short to long meridional colpi; in *Aglaia* the colpi are very short and indistinct. Tetracolporate pollen is rarely loxocolpate. The colpus ends are sometimes bifurcate. The endoapertures are circular to lalongate pori. Pollen of most genera has distinctly thickened ecto- and endoaperture margins (costae). Fastigiate apertures are known in several species of *Munronia* and *Turraea*.

Exine thickness is 1–3 µm. Little is known of the exine structure. The sexine and nexine can mostly be distinguished with light microscopy, but the infratectum is rather thin, and probably usually columellate. The ornamentation is mostly psilate to scabrate, with or without small perforations. Sometimes the exine surface is irregularly undulate to verrucate-rugulate or ± reticulate (*Carapa*, *Munronia*, *Trichilia*, *Xylocarpus*). Finely striate ornamentation was observed in the pollen of *Lansium* (Durdana Yunus & Nair, l.c.) and striate ornamentation in that of *Ekebergia* (Straka & Friedrich, l.c.).

As far as *Meliaceae* pollen is known, there are no significant differences between the subfamilies. Pennington & Styles (l.c.) considered prolate-spheroidal to subprolate, tetracolporate, psilate pollen constant in the *Swietenioideae*, but a literature survey has shown that oblate-spheroidal pollen, pentacolporate pollen and scabrate pollen also occur in this subfamily (e.g. Erdtman, l.c.; Chang & Wang, l.c.; Sowunmi 1974; Durdana Yunus & Nair, l.c.). In a few cases pollen morphology proved to be valuable in transferring or segregating genera (see Pennington & Styles, l.c.). *Turraea* is a comparatively eurypalynous genus, showing, besides meliaceous types, pollen unique in the family.

Pollen morphology confirms that *Nymania* and *Pterorhachis* belong to the *Meliaceae*. Pollen like that of *Cedrelopsis* and *Ptaeroxylon*, which is tricolporate and distinctly reticulate with finely reticulate colpus margins (Leroy et al. 1990), does not occur in the *Meliaceae*, but is common in the *Rutaceae* and *Simaroubaceae* (*Zanthoxylum* type). This was one of the reasons for removing these genera from the *Meliaceae* (see Pennington & Styles, l.c.). Pollen with 4 or 5 colporate, costate apertures, like that of many meliaceous genera, though usually with a ± reticulate ornamentation, also occur in a number of genera of the subfamily *Aurantioideae* of the *Rutaceae*.

Fossil pollen attributed to modern *Meliaceae* is known from a few Tertiary localities (Muller 1981). The 3–5-colporate pollen genus *Meliapollis* is not necessarily related to modern *Meliaceae* pollen (Thanikaimoni et al. 1984).

References: Bonnefille, R. & G. Riollet, Pollens des savannes d'Afrique orientale (1980). — Chang, K.T. & F.H. Wang, Acta Bot. Sinica 5 (1956) 253–266. — Durdana Yunus & P.K.K. Nair, Pollen morphology of Indian Geraniales (1989). — El Ghazali, G.E.B., Review Palaeobot. Palynol. 76 (1993) 99–345. — Erdtman, G., Pollen morphology and plant taxonomy (1952). — Leroy, J.-F., D. Lobreau-Callen & M. Lescot, Bull. Mus. Nat. Hist. Nat. Paris, IV, 12 (1990) 43–57. — Muller, J., Bot. Review 47 (1981) 1–142. — Oltmann, O., Pollen et Spores 17 (1975) 15–42. — Pennington, T.D. & B.T. Styles, Blumea 22 (1975) 419–540. — Sowunmi, M.A., Grana 13 (1974) 145–186. — Straka, H. & B. Friedrich, Trop. Subtrop. Pflanzenwelt 51 (1984) 27–43. — Thanikaimoni, G., C. Caratini, B.S. Venkatachala, C.G.K. Ramanujam & R.K. Kar, Trav. Sect. Sci. Tech. Inst. Fr. Pondichéry 19 (1984) 1–92. — Tissot, C., H. Chikhi & T.S. Nayar, Publ. Dép. Écol. Inst. Fr. Pondichéry 35 (1994) 1–133.

Seeds — The seeds of *Meliaceae* are some of the most diverse and intricate in structure so far investigated. The following is largely taken from Cheek's thesis (1989). The seeds are usually pendulous and epitropous [but apotropous in the Australian *Synoum* (*Guareeae*)] in relation to the placenta. They are usually anatropous (but hemi-anatropous in most *Turraeeae* and *Cipadessa*), occasionally orthotropous as in all *Chisocheton* and some *Guarea* spp., campylotropous in e.g. *Nymania* (*Turraeaeae*), usually with a

distinct funicle and raphe. Integument vascularization occurs in a few bitegmic genera, e.g. *Chisocheton* and *Heynea* (vascularized tegmen), *Dysoxylum* and *Trichilia* (vascularized testa) and is usual in pachychalazal seedcoats. In the *Guareeae*, arillate seeds characterize genera with bitegmic seeds, sarcotestal ones the unitegmic genera, while both conditions are found in *Chisocheton* and *Dysoxylum*, the genus with the greatest variation in seed anatomy investigated by Cheek. The single most taxonomically useful layer of the seedcoat in the majority of genera is the exotegmen: dimensions of the fibres and their wall characters but also the number of cell layers. However, in *Dysoxylum*, for example, the type of seed appendage and its organization are more helpful in recognizing species groupings as the exotegmen is reduced and poorly developed there. From his survey of the family, Cheek concludes that the ancestral meliaceous seed was comparatively large and bitegmic, with a small chalaza and a funicular-raphe-aril. From such can be derived the unitegmic sarcotestal state and the unitegmic 'pseudoarillate' state seen in Malesian species.

Reference: Cheek, M.R., The systematic seed anatomy of the Meliaceae. Unpubl. D.Phil. thesis Oxford Univ. (1989).

CYTOTAXONOMY

There is a wide range of somatic chromosome numbers from 2n = 16 (*Sandoricum koetjape*) to c. 360 in some African *Trichilia* spp., with polyploid series in some genera, e.g. *Aphanamixis* and *Aglaia* and within species, e.g. *Chisocheton cumingianus*. Much is summarized by Khosla & Styles (1975) and Styles & Khosla (1976) with further discussion by Datta & Samanta (1977) and counts for *Aglaia* provided by Pannell (1992) and *Chisocheton* by Mabberley (1979).

References: Datta, P.C. & P. Samanta, Cytologia 42 (1977) 197. — Khosla, P.K. & B.T. Styles, Silvae Genet. 24 (1975) 73–83. — Mabberley, D.J., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 301–386. — Pannell, C.M., Kew Bull., Add. Series 16 (1992). — Styles, B.T. & P.K. Khosla, Cytol. & reprod. biol. of Meliaceae, in: J. Burley & B.T. Styles (eds.), Tropical trees: variation, breeding and conservation (1976) 61–67.

PHYTOCHEMISTRY AND CHEMOTAXONOMY

(R. Hegnauer)

Meliaceae belong to *Rutales* s.str. comprising *Rutaceae, Meliaceae, Simaroubaceae, Cneoraceae* and *Burseraceae* (Waterman & Grundon 1983). A chemical key character of this order (if *Burseraceae* are excluded) is the synthesis and accumulation of bitter and biologically active nortriterpenoids called limonoids, meliacins and quassinoids depending on structural features and occurrence. These oligonortriterpenoids derive from tetracyclic triterpenes which are known as protolimonoids. Moreover, each family of this order has its own main patterns of secondary metabolites. Recently, *Meliaceae* have interested many phytochemists and biologists, because they yield many compounds with insect-antifeeding, insect-repellent or/and insecticidal properties, and because many members of this family are highly esteemed in traditional medicine of most continents.

A number of phytochemical review treatments of *Meliaceae* are available in recent literature, e.g. Hegnauer 1969, 1983, 1990; Waterman & Grundon 1983. Furthermore, many reviews are devoted to the chemically complex limonoids, which in the case of *Meliaceae* are sometimes called meliacins; see e.g. Arnason et al. 1989, 1993; Champagne et al. 1992; Ley et al. 1993; Rembold 1983, 1989; Rembold & Puhlman 1993; Saxena 1989; Taylor 1983; Triterpenes 1984–1994.

References alluded to in the above reviews are only exceptionally repeated in the following phytochemical survey in which metabolites of *Meliaceae* are arranged following Hegnauer (1983).

A. *Essential oils* — Idioblasts containing oleo-resins seem to be ubiquitous. Usually these excretory cells contain mono- and sesquiterpenoids as their main steam-volatile constituents. Some of the sesquiterpenoids, like the aphanamols of *Aphanamixis polystachya* (*A. grandifolia*), a 3-oxo-α-bourbonene derivative from *Lansium domesticum* and 8-hydroxycalamenene from seeds of *Dysoxylum* spp. have piscicidal properties. *Dysoxylum spectabile* (A. Juss.) Hook. f. from New Zealand produces a fruit oil containing an ant-repellent sesquiterpenoid which can be interpreted as a hydrated β-santalene (Russell et al. 1994). Some taxa have a distinct onion- or garlic-like smell and are assumed to produce volatile sulphur compounds. In fact, cyclic tri- and tetrasulfides have been isolated from fresh leaves of *Azadirachta indica* and leaves of *Dysoxylum mollissimum* subsp. *molle* (*D. richii*) have yielded dysoxysulfone, $C_5H_{12}O_4S_5$.

B. *Arylpropanoids and arylpropanoid-dimers (lignanoids)* — The ubiquitous cinnamic acids are not lacking in *Meliaceae*, but usually they are not accumulated in large amounts, neither free nor as esters. *p*-Coumaric and caffeic acids have been detected in several species, and *Azadirachta indica* produces methyl grevillate; grevillic acid is 2,5-dihydroxycinnamic acid. Cinnamic acid itself occurs sometimes as an amide (see below, sub G–H) or esterified with limonoids. Contrary to what occurs in some *Rutaceae*, *Meliaceae* obviously do not accumulate appreciable amounts of steam-volatile phenylpropanoids in their essential oils. The methylether of lariciresinol, a lignan, has been isolated from leaves of *Turraea nilotica* Kotschy & Peyr. (Africa), and small amounts of a benzofuranoid neolignan having insect-antifeedant properties and called melianoninol has recently been isolated from fruits of *Melia azedarach* (Xu et al. 1992).

C. *Acetogenins (= Polyketides)* — Accumulation of pure acetogenins is exceptional in the family. 5,7-Dihydroxy-2-methylchromone (= noreugenin, a pentaketide) occurs free and combined in 8-position with 3-hydroxy-N-methylpiperidine to the alkaloid rohitukine in leaves of *Aphanamixis polystachya* (*Amoora rohituka*). 4-Methoxy-5-methylcoumarins are assumed to be produced along the polyketide pathway. Ekersenin from *Ekebergia capensis* Sparrm. (*E. senegalensis*) and siderin from *Toona ciliata* (*Cedrela toona*) belong to this group and are probably also pentaketides.

D. *Coumarins* — True coumarins are lactones of *cis*-2-hydroxycinnamic acids; they represent a characteristic group of arylpropanoids. Simple coumarins like umbelliferone, aesculetin, scopoletin, scoparone and isofraxidin have been isolated from several species. Rutaceous-type derivatives of isoprenylated coumarins, however, are of rare occurrence in *Meliaceae*. Such coumarins have been isolated recently from seeds of a variety of

Toona ciliata (bergaptene, a furanocoumarin) and from bark of *Ekebergia capensis* (xanthoxyletin, a 2,2-dimethylchromenoid coumarin).

E. *Flavonoids* — Flavonoids are of mixed biogenetic origin (*p*-coumaric acid + 3 acetates). Their patterns depend on plant parts and taxa. The patterns known from *Rutales* (including *Meliaceae*) were discussed by Harborne (1983). The flavonol quercetin is of common occurrence in *Meliaceae*; it is sometimes accompanied by kaempferol and/or myricetin. Rutin, the 3-rutinoside of quercetin, has been isolated from several taxa. O-Polymethylation and C-prenylation of flavonoids, which are characteristic of many rutaceous plants, seem to be rather exceptional in *Meliaceae*. Examples are syringetin and 2,3-dihydrosyringetin from wood of *Soymida febrifuga* (Roxb.) A. Juss. (India), tabularin (= 5,7-dihydroxy-6,2',4',5'-tetramethoxyflavone) from leaves of *Chukrasia tabularis* and the 8,3'-diprenylated 5,7-dihydroxy-4'-methoxyflavanone from leaves of *Azadirachta indica*. A C-methylated flavonoid, the 3-xyloside of 8-methylquercetin, has been isolated from root bark of *Aphanamixis polystachya*. A new type of flavonoids has recently been reported from the bark of *Aglaia tomentosa* (*A. ferruginea*) by Dean et al. (1993); ferrugin, $C_{26}H_{26}O_6$, can be interpreted as a condensation product of 5,7-dimethoxyisoflavone with a C_6-C_2- or a decarboxylated C_6-C_3-unit; if this biogenetic assumption is correct, it represents an isoflavano-norlignan. Hitherto flavones have seldom been observed in the family. The sporadic occurrence of flavones is illustrated by the aforementioned tabularin and by the apigenin glycosides of *Melia azedarach* (Tang & Eisenbrand 1992). Flavanones and chalcones are also rare *Meliaceae* constituents.

F. *Tannins and tannin precursors* — Many *Meliaceae* are tanniferous plants. Tannins accumulate mainly in barks and roots and belong to the proanthocyanidin group (= condensed tannins). Some species produce barks with up to 20% tannins and are used locally for tanning purposes. Catechins and gallocatechins have been isolated from barks of *Dysoxylum spectabile, Melia azedarach* and *Azadirachta indica*, and wood of *Toona ciliata* (*Cedrela toona*) has yielded a procyanidin. Bark of *Azadirachta indica* also contains gallic acid. This suggests that condensed tannins may be accompanied by gallotannins in some taxa. Ellagic acid and ellagitannins have not yet been detected in the family.

G–H. *Protoalkaloids and alkaloids* — In contrast to *Rutaceae* no family-specific types of alkaloids are known from *Meliaceae*. In this summary of present knowledge seven types of alkaloid-like substances will be discussed below. True alkaloids are represented by four distinct types. 1) Ekeberginine from *Ekebergia capensis* (*E. senegalensis*) is a carbazole alkaloid; it is a position isomer of indizoline of *Clausena indica* Oliv. (*Rutaceae*). Ekeberginine and xanthoxyletin mentioned sub coumarins strengthen the biochemical link between *Rutaceae* and *Meliaceae* indicated by limonoids. 2) The antifeedant 2-chinolone alkaloid N-methylflindersine from roots of *Xylocarpus granatum* forms another biochemical link between *Rutaceae* and *Meliaceae*, just as does 3) acetonyldihydrochelerythrine, a phenanthridine alkaloid isolated from the same plant material. 4) Alkaloids of *Dysoxylum lenticellare* Gillespie (Fiji), e.g. dysoxyline, 3-epischelhammericine, dysazecine and others all belong to the phenylethylisoquinoline group of alkaloids occurring erratically in Spermatophytes. A recent addition to these alkaloids

of *D. lenticellare* are the homoerythrinane 2α-methoxycomosivine and the secohomoerythrinanes or lenticillaranes lenticillarine, 2-hydroxy- and 2-methoxylenticillarine (Aladesanmi et al. 1994). The remaining three types of nitrogen-containing secondary metabolites are rather alkaloid-like compounds than true alkaloids. 5) Pyridine derivatives such as 3-hydroxypyridine isolated in trace amounts from the bark of *Entandrophragma cylindricum* (Sprague) Sprague (Africa) and two diesters of the limonoid phragmalin with one molecule of nicotinic acid (giving basic properties to these esters) and one molecule of isobutyric acid isolated from the bark of *E. caudatum* Sprague. 6) Complex cinnamic acid amides of *Aglaia* species, e.g. pyrimidatin, $C_{20}H_{22}N_2O_2$, a bisamide of putrescine, from leaves of *A. silvestris* (*A. pyramidata*); related bisamides are piriferine from *A. edulis* (*A. pirifera*) and odorine, 5'-epiodorine and odorinol from *A. odorata* and *A. elaeagnoideae* (*A. roxburghiana*) (Saifah & Puripattanavong 1993). Rocaglamide, a more complex amide, was originally isolated from *A. rimosa* (*A. elliptifolia*) and later together with the similar compounds desmethylrocaglamide, rocaglaol and methyl rocaglate from *A. odorata* (Janprasert et al. 1993; Ishibashi et al. 1993). Roots of *A. odorata* yielded a still more complex rocaglamide-type compound, $C_{31}H_{28}N_2O_6$, which contains a pyrimidinone ring, probably derived from the putrescine amide of rocaglaic acid (Kokpol et al. 1994). Rocaglamide-type compounds have insecticidal properties. The genus *Aglaia* is believed to be very promising for the development of new insecticides of plant origin (Arnason et al. 1993; Satosook et al. 1994). 7) The last type of alkaloid-like compounds of *Meliaceae* was already mentioned sub C, i.e. rohitukine. Alkaloid and alkaloid-like constituents seem to occur rather frequently in the family; most of them have not yet been investigated. Present knowledge suggests that these compounds characterize individual species and genera rather than larger taxonomic entities.

I. *Bitter tetranortriterpenoids (limonoids or meliacins) and their tetracyclic triterpenoid precursors* — Probably every meliaceous plant accumulates one or several types of limonoids. Agostinho et al. (1994) recently discussed the infra-familiar taxonomic meaning of meliacins (compare also Silva et al. 1984 and 1988) and their possible role in plant defence. References to this much studied class of compounds have already been given in the introductory notes. Some additional information is included in the following remarks. Precursors of meliacins or limonoids are euphane(tirucallane)-type tetracyclic triterpenoids like odoratone from *Cedrela odorata* or melianone and melianol from *Melia azedarach*; they have a polyoxygenated side-chain at C-17. Limonoid biosynthesis starts with the so-called apo-rearrangement, i.e. the migration of a double bond and one methyl group. Examples of such apo-euphanoid or apo-tirucallanoid protolimonoids are grandifoliolenon from wood of *Khaya grandifolia* C. DC. (Africa), 21-O-acetyltoosendantriol from *Melia azedarach* (*M. toosendan*) (Tang & Eisenbrand 1992) and the dysorones from leaves of the New Caledonian *Dysoxylum roseum* (Baillon) C.DC. (Adesanya et al. 1991). The next biogenetic step leading to limonoids is an oxidative loss of four C-atoms of the side-chain (C-24 to C-27). Much chemical, chemo-ecological and pharmacological work has been performed with limonoids of the neem tree (= margosa tree) (Van der Nat et al. 1991; Stone 1992; Govindachari 1992). Recently one of its

main anti-insect principles, azadirachtin-A was got into crystalline form. This made it possible to confirm its highly complex structure by X-ray diffraction studies (Govindachari et al. 1994; Kabaleeswaran et al. 1994). Neem seed oil also contains limonoids with antifeedant activity against white ants (*Reticulitermes speratus*: Ishida et al. 1992). Six *Chisocheton* species cultivated in the Botanic Gardens Bogor, Java, have been investigated for their insect-deterrent properties. Five of them furnished leaf and twig extracts with antifeedant activity; two meliacins with a γ-lactone ring were isolated from *C. pentandrus* (*C. microcarpus*) (Gunning et al. 1994). Tang & Eisenbrand (1992) reviewed the chemical constituents and their biological properties of *Melia azedarach* (incl. *M. toosendan*). New limonoid antifeedants have been isolated from root bark of Chinese plants and from stem bark of plants of *Melia azedarach* growing in Okinawa (Nakatani et al. 1994). Limonoids of *Trichilia* species have been shown to inhibit growth of lepidopteran larvae when incorporated in their diet and after topical application; one of the active principles of *T. hirta* L. (America) was identified with hirtin (Satasook et al. 1994). *Xylocarpus granatum* and *X. rumphii* ('*X. moluccensis*') growing in Fiji yielded the new limonoids xyloccensin-I and -J (Alvi et al. 1991).

J. *Diterpenoids and triterpenoids* — Isoprenoid metabolism of *Meliaceae* yields limonoids and protolimonoids in the first instance, but diterpenes and 'normal' triterpenes are by no means lacking. The acyclic diterpene geranylgeraniol has been isolated from the wood of *Toona ciliata* (*Cedrela toona*). Diterpenoids have also been isolated from barks of *Azadirachta indica* (sugiol, nimbiol, a bisnorditerpene, and nimbidiol, a trisnorditerpene), from leaves of *Aphanamixis polystachya* (aphanamixol) and from leaves of *Dysoxylum lenticellare* (phyllocladene, 8-hydroxysandaracopimarene, ferruginol and ferrubietolide, a dimeric abietane-type diterpene). The non-protolimonoid triterpenes are represented in the family by several types. The sapelenins of *Entandrophragma cylindricum* are tetra- or hexahydroxy derivatives of partially hydrogenated squalene; sapelenins-A and -C are monoacetates (Ngnokam et al. 1993). The tetracyclic triterpenes are represented in the family by three types. Heyneic acid from *Heynea trijuga*, kulinone and kulactone from *Melia azedarach* and the rather widespread cycloartenol and 24-methylenecycloartanol belong to the euphane-tirucallane group. The dammarane group is represented by aglaiol from leaves of *Aglaia odorata* and richenone, richenol, richenoic acid and five other compounds isolated from leaves of *Dysoxylum mollissimum* subsp. *molle* (*D. richii*); richenoic acid, eichlerianic acid and shoreic acid are A-ring seco-dammaranes (Aalbersberg & Singh 1990). Ocotillone, cabraleone and eichlerianic acid and other dammarane-type triterpenes had previously been isolated from the wood of *Cabralea canjerana* (Vell.) Mart. (*C. eichleriana*) and subsp. *polytricha* (A. Juss.) T.D. Penn. (*C. polytricha*). Recently, stem bark of *Aglaia leucophylla* (Malaysia) yielded ocotillone, cabraleone, ocotillol, cabralealactone, eichlerianic acid and a new 3,4-seco-tirucallane-type C^{30} diacid and its monomethyl ester (Benosman et al. 1994). Onocerane-type tetracyclic triterpenes occur erratically in tracheophytes. In *Meliaceae* they are represented by onoceradienone and the *seco*-derivatives lansic and lansiolic acids (*Lansium domesticum*). The more or less ubiquitous pentacyclic triterpenes of the lupeol- and α- and β-amyrin-series have been hitherto isolated from a rela-

tively small number of *Meliaceae*. Examples are katonic acid from wood of *Lansium domesticum*, walsurenol from leaves of *Walsura tubulata* Hiern (India), α- and β-amyrin, hederagenin and lupeol benzoate from wood of *Swietenia mahagoni* and betulin and betulinic acid from roots of *Amoora canarana* (Turcz.) Hiern (= *Aglaia lawii*).

K. *Saponins* — The usual saponins are aphrogenic and hemolytically active glycosides with one or two sugar chains attached to an alcoholic hydroxyl of an aglycone (= sapogenin). Sapogenins are triterpenoids or steroids (usually C_{27}). Sapogenins combined with a single hexose or pentose are saponin-like compounds rather than true saponins. Common phytosterols, e.g. sitosterol and stigmasterol, and polyhydroxypregnanes also occur frequently as monosides or biosides and may have saponin-like properties. Present knowledge suggests that true saponins are of rare occurrence in *Meliaceae*, but that saponin-like constituents are rather common. Examples of such saponin-like glycosides are 3-mono- and biosides of stigmastadienol, poriferasterol and aglaiol (*Aphanamixis polystachya*), the lansiosides of fruits of *Lansium domesticum* and a norcycloswietenol-3-glucoside from wood of *Swietenia mahagoni*. New additions to saponin-like glycosides of *Meliaceae* are the cumingianosides of *Dysoxylum cumingianum*; they are acetylated monoglucosides of tetracyclic triterpenes with a 14,18-cyclo-apoeuphane-type skeleton and are accompanied by a similar trisnor-compound (cumindysoside-A; C_{25}–C_{27} lost) and tetranor-compound (cumindysoside-B; C_{24}–C_{27} lost) (Kashiwada et al. 1992). Toosendanoside, the 2-glucoside of a tetrahydroxypregnane from *Melia azedarach* (*M. toosendan*) (Nakanishi et al. 1988) seems to belong to the same group. Recently a number of glucosides or glucuronides of limonoids have been detected in the family (e.g. Tang & Eisenbrand 1992). Glycosidic limonoids (or meliacins) may also possess saponin-like properties.

L. *Unclassified secondary metabolites* — A number of erratically occurring compounds should be mentioned here. *p*-Hydroxyacetophenone was isolated from stems of *Dysoxylum lenticellare*. Bark of *Khaya senegalensis* A. Juss. (Africa) contains the allergenic yellow quinone 2,6-dimethoxy-*p*-benzoquinone which occurs in many members of *Simaroubaceae*. Glycosylated anthraquinones of uncertain biogenetic origin have been isolated from *Aphanamixis polystachya* and *Melia azedarach*.

M. *Mucilages* — Gummosis is not uncommon in *Meliaceae*. Gums exuded by *Azadirachta indica*, *Carapa procera* DC. (tropical America & Africa), *Cedrela odorata* and several *Khaya* species have been studied chemically. They are acidic heteropolysaccharides which are partially acetylated and release easily acetic acid during purification. The gum exudate of the neem tree has been thoroughly investigated and shown to be a proteoglycane (heteropolysaccharides firmly combined with proteins) (Van der Nat et al. 1991).

N. *Storage products of seeds* — Many *Meliaceae* produce endospermless or endosperm-poor seeds which have their reserves stored in the cotyledons which are also rich in large excretory cells. There is no family-characteristic pattern of seed storage products. Many species store mainly oil and proteins. Others have predominantly oil or predominantly proteins. Starch is absent in ripe seeds of many taxa, but was reported to be present in large amounts in '*Amoora*' (Netolitzki 1926). The chemistry of seed oils varies within the family. Some taxa, notably *Entandrophragma* (three species investi-

gated) have vaccenic acid as a main component. Seed oils of *Melia* (3 species) contain more than 60% of linolenic acid, and a number of taxa have seed oils with over 50% of saturated fatty acids (12:0–18:0). Obviously fatty acid patterns of seed oils are rather characteristic at infrageneric and generic levels than at suprageneric levels.

O. *Inorganic compounds* (see also the paragraph on Vegetative anatomy, p. 5) — Some *Meliaceae* accumulate small to moderate amounts of silica. Silica deposition in leaves has been reported for six species of *Cedrela* and for one species of each of the genera *Soymida*, *Swietenia, Carapa* and *Xylocarpus*; 25 species had leaves without silicated cell walls (Edman 1936). In woods of some species silica bodies occur in ray and parenchyma cells. Such woods contain between 0.05 and 3.4% of silica and belong to the genera *Aphanamixis*, *Chisocheton*, *Dysoxylum* (exceptionally), *Entandrophragma* (p.p.), *Guarea* (p.p.) and *Trichilia* (most species) (Amos 1952; Savard et al. 1954; Ter Welle 1976). The character may have some taxonomic importance up to generic level.

Chemotaxonomy — By their highly versatile limonoid metabolism *Meliaceae* are clearly related to *Rutaceae* and other families of *Rutales*. Each family of *Rutales*, however, has distinct features of secondary metabolism. *Meliaceae*, for example, lack totally or nearly totally classes of compounds present in many *Rutaceae* (prenylated coumarins; anthranilic acid derived alkaloids) and *Simaroubaceae* (canthinone-type alkaloids). For infrafamiliar taxonomy the limonoids (or meliacins) offer possibilities. Taxonomists should be very cautious and careful, however, in using them, because our knowledge is still extremely fragmentary. Far-reaching phylogenetic conclusions (Silva et al. 1984; Agostinho et al. 1994) are premature. Everyone who intends to make taxonomic use of secondary metabolites in *Rutales* should start with reading Waterman (1990).

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TAXONOMY

Historical — This is summarized by Pennington & Styles (1975). As far as Malesia is concerned, the study of the family has been dominated by Miquel (1868), whose 'Monographia meliacearum archipelagi indici' is a pioneering example of the monographic method he championed, and Harms (1896, 1940), who prepared accounts for both editions of Engler & Prantl's Die Natürlichen Pflanzenfamilien and described many dozens of Malesian species, particularly from the German possessions in New Guinea. His work gave a firm foundation for Pennington & Styles's generic monograph of the family (1975), largely based on Pennington's doctoral thesis of 1965 in the University of Oxford, which has been a centre of study for this family for several decades. Much remains to be studied, however, particularly in the fields of reproductive and dispersal biology (see above). Even at the alpha-taxonomic level, local workers can still contribute a great deal: collectors should be encouraged to collect flowers and ripe fruits in spirit, to note the largest size of leaves and the number of leaflets, to be sure to collect apical buds and to try to characterize the smell of broken branches.

Present arrangement — The family is divisible into four subfamilies. A putative fifth, the monotypic *Neomangenotioideae* Leroy, from Madagascar, has been referred to *Commiphora* (*Burseraceae*); see Cheek & Rakotozafy (1991). Two of the subfamilies, both monotypic, are restricted to Madagascar and to a certain extent provide links between the other two which are by far the largest: *Melioideae* and *Swietenioideae*, both pantropical with the first much larger in terms of numbers of genera and species than the second.

Subfamily *Melioideae* is divisible into seven tribes (Pennington in Pennington & Styles 1975) with 36–38 genera. All tribes are represented in Malesia, but only two (*Guareeae* and *Trichilieae*) are pantropical, while two more are restricted to the Old World (*Turraeeae* and *Melieae*), the remaining three being restricted to Indomalesia and the western Pacific (*Vavaeeae*, *Aglaieae* and *Sandoriceae*). The *Trichilieae*, *Guareeae* and *Aglaieae* are very closely allied and have been treated as one tribe by some workers, but the other four are more isolated around this core. With the possible exceptions of *Lansium* and *Sandoricum*, species of which are widely planted such that their natural distribution is blurred now, and maybe an undescribed genus here retained in *Turraea*, no genus is restricted to the Malesian region.

Subfamily *Swietenioideae* is divisible into three tribes with 13 genera. All tribes are represented in Malesia, but by just one genus of each. *Cedreleae* are amphipacific in distribution; the other two tribes (*Swietenieae* and *Xylocarpeae*) are pantropical.

At the generic level, the family demonstrates some remarkable transpacific affinities: Asiatic and Malesian *Toona* with neotropical *Cedrela* and *Dysoxylum* and *Chisocheton* of Indomalesia with *Guarea*, *Ruagea* and *Cabralea* of the Neotropics. *Xylocarpus* of East Africa to the Pacific is closely allied to *Carapa* of the Neotropics to West Africa.

Types of species and their variation patterns — There are examples of the three major sorts of infraspecific variation in tropical trees pinpointed by Whitmore (1976), viz. the clear-cut, more-or-less uniform species, e.g. *Dysoxylum arborescens*, while ecogeographically definable infraspecific taxa can be recognized in *D. mollissimum* and *D. acutangulum*, with more-or-less distinctive subspecies on each side of Wallace's Line and in taxa treated as specifically distinct; there are similar affinities e.g. *Dysoxylum cauliflorum* and the closely allied *D. cumingianum* to the west, *D. pettigrewianum* to the east.

The greatest difficulty is encountered with the third type, however, where there is insufficient ecogeographical differentiation yet there are sometimes recognizably distinct types at any one locality nevertheless: careful analysis of the massive amount of material now available shows that a number of species formerly recognized by earlier workers must be included in a complex around *Chisocheton lasiocarpus* and *Aphanamixis polystachya* for example. Such a variation pattern is not infrequently encountered in *Meliaceae*, notably in New Guinea, where it is found in many other families too. Extending out into the Pacific, such is also seen in *Vavaea amicorum* (Pennington 1969). However, A.C. Smith (1985) who resurrects several species in that complex for a local flora (Fiji), writes "It is not realistic to imply that overlapping characteristics in every case prohibit the recognition of taxa at the specific level. If one should propose that all species must be distinct from their congeners in all features, a species concept would be

unattainable in most genera of flowering plants, and the genus would become the lowest category to mirror reality [sic!]. It would seem logical to take into consideration such dispersal barriers as distance, water expanses, topography, time, and many other isolating factors in the recognition of taxa that, however superficially similar, are quite recognizable to many observers as 'species', albeit with occasional overlapping characteristics." This is, then, an attempt to use a 'biological species concept' along the lines of the basic unit for classification being the breeding population. This is all fine theory but such theory has as its basis the results of experimental taxonomy and for the great majority of tropical woody plants such are neither available or even possible to obtain such that taxonomic work is inevitably based on museum studies: to pretend otherwise is to mislead. Moreover, what is the classification for? On one hand, it may be useful to give names of the 'species' or provenance at the local level, but, on the other, finely discriminated 'species' to which museum materials are difficult or impossible to assign with certainty scarcely encourage confidence in a monograph.

If it suits local workers to resurrect species for local usage, then so be it: it *may* turn out that such prove to have biological significance (apomicts, jordanons, sibling species, yet they *may* represent infraspecific polymorphic variation), but as yet such 'explanations', like supposed introgression or other hybridity, must be considered with some caution. In my opinion, a discussion of variation within a complex, as untidy as it seems, is a fairer picture of the state-of-affairs than is forcing the facts into a false clarity exemplified by a linear series of neatly set-down binomials, the legacy of the essentialists imbued with Linnean artificiality and the Great Chain of Being. It must be realized that there is no *one* classification in these difficult cases, nor indeed any other – a chemical classification is a valid classification mirroring reality as perceived by creatures able only to sense chemical distinctions. So often, evidences from cytology, chemistry and other sources are considered 'useful' only if they bolster up those classifications based on the features of dried cellulose and lignin discernible optically and, as human beings perceive most of their world in this last way, such an approach is readily defended, though it does not make such classifications any better from a philosophical point of view.

Relationships of the family — These are amply discussed by Pennington & Styles, who argue for the integrity of the family, which is, nevertheless, closely allied to *Rutaceae*, some of which have very similar limonoids, the oxidized terpenes which characterize the family (see 'Phytochemistry') and provide some of the most significant plant products in terms of potential insecticides. The limonoids are recorded otherwise only from *Cneoraceae* and *Harrisonia* R.Br. ex A.Juss., currently placed in *Simaroubaceae* but perhaps better considered rutaceous.

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USES

Timber — The timbers of certain *Meliaceae* are some of the most sought after in the world, such that natural stands have been much depleted and serious conservation measures have been proposed for wild mahoganies (*Swietenia* spp.) in tropical America (see e.g. Knees & Gardner 1983; Newton et al. 1993b). The original 'mahogany' of Hepplewhite and Chippendale was *S. mahagoni*, allowing the construction of more graceful and woodworm-proof furniture than could the oak and walnut previously used in Europe: this species has suffered severe genetic erosion and most 'mahogany' (if meliaceous at all!) seen today is derived from *S. macrophylla* introduced to the Old World, probably from Honduras, in 1876 and described from material cultivated in India. The other important timbers are also generally *Swietenioideae*, notably toon, *Toona ciliata* from India to Australia ('red cedar'), where most of it has been long cut out, having been the most desirable timber in that continent. Others include the neotropical *Cedrela odorata* and species of the African genera *Entandrophragma* (*E. sapele, E. utile*), *Khaya* (African mahogany) and *Lovoa* (Nigerian golden walnut). Besides the *Toona* spp. and *Chukrasia tabularis*, the chickrassy wood of Malesia, indigenous species are not of commercial significance in the world timber market, despite their large boles, though the wild forms of *Melia azedarach* yield a second-quality timber. Locally important were several species of *Dysoxylum*, notably the gigantic species *D. mollissimum* (formerly the tallest trees of all in Java) and *D. acutangulum*. Locally, some *Aglaia* spp., *Anthocarapa nitidula, Azadirachta excelsa, Dysoxylum* spp., and *Walsura* spp. have been used for construction and furniture, while *Xylocarpus* wood is hard and used for boatbuilding. The standard name for *Dysoxylum* timber in Malaysia is jarum-jarum (a Sabah name, the ASEAN standard name being the Indonesian membalun). It and the timbers of *Aglaia* (incl. *Amoora*; bekak, pasak) and *Azadirachta* (sentang), *Chukrasia* (surian batu), *Lansium* (langsat), *Sandoricum* (sentul), *Toona* spp. (limpaga) and *Xylocarpus* (nyireh) are discussed by Wong (1982), but see 'Vernacular names' below.

Silviculture — Most *Meliaceae* grown for timber in Malesia, then, are exotics, notably the neotropical *Swietenia mahagoni*, *S. macrophylla* and *Cedrela odorata*, which have all also been grown as shade or avenue trees though *Swietenia* is the only meliaceous genus treated in the PROSEA Handbook on Major commercial timbers (Prawirohatmadjo et al. 1993). The most serious problem besetting plantation forestry of *Meliaceae* is the attacks of the moths (*Lepidoptera, Pyralidae*) of the genus *Hypsipyla*, larvae of which burrow into young plants and seedlings, causing their collapse and death, though *Melioideae* seem to be rarely attacked – a good argument for their promotion as plantation trees. The shoot-borer is perhaps one of the most economically important insect pests in tropical forestry. In the Neotropics, the moths appear to be attracted by a chemical, possibly an alkaloid or limonoids, allied to substances which, in species from other parts of the world, are toxic to their local moths. Thus, *Toona ciliata* is resistant to attack in Costa Rica and this resistance may be transferred to susceptible *Cedrela odorata* if a scion of this is grafted on to a stock of *Toona*. *Chukrasia tabularis*, on the other hand, is not resistant in Costa Rica. There have been many attempts at biological control

of the moths, for externally applied insecticides have little effect and systemic ones are expensive (Whitmore 1976). Mixed and enrichment planting with non-susceptible species has been shown to reduce damage and there are possible advances to be made in breeding resistance to attack. See Newton et al. (1993a) for further details.

Other uses — The locally very important fruit trees, *Lansium domesticum* (langsat) and *Sandoricum koetjape* (sentul), exist in a number of forms, wild, cultivated and naturalized, though they are not grown on a commercial plantation scale, those reaching markets being largely those selected from village trees. A good langsat may be worth more as a proposition than a good durian tree. Some species of *Aglaia* have acceptable fruits and one of these, *A. korthalsii*, is widely grown in villages in the north of the Malay Peninsula. Seeds of a number of species of *Chisocheton* and *Aphanamixis* yield an oil which has been used as an illuminant, while those of *Lansium domesticum* are used in arrow poisons, as is the bark.

The bitterness (due to the limonoids) of the barks of *Meliaceae* has long been known and they have been used in medicine, some being those eagerly sought by Europeans in the eighteenth century. *Soymida febrifuga* (Roxb.) A. Juss. (*Swietenioideae*) from India was much prized but barks of other genera have been used, notably in the Malesian flora, species of *Aphanamixis, Chukrasia, Lansium, Sandoricum, Toona, Trichilia* and *Xylocarpus*, while the whole plant of *Munronia pinnata* is an important item of materia medica in southern Asia. Extracts from *Walsura monophylla* are being commercially tested for the treatment of cancer and AIDS in the U.S.A. Some others are poisonous in part, e.g. seeds of *Dysoxylum* spp., which contain the toxic dysoxylum acid. The bark and indeed, the leaves of the exotic *Azadirachta indica*, the neem, are powerful insecticides and this tree (q.v., and see also the paragraph on phytochemistry, p. 8) has a host of uses including planting in the reclamation of derelict land: it is perhaps one of the most all-round useful trees of Asia. The tetranortriterpenoids which are responsible for the insecticidal (and molluscicidal in e.g. *Khaya* spp. bark and seeds) properties have aroused considerable commercial interest and have been examined in a number of genera for their use as biological pesticides: this is dealt with genus by genus below. The biological activities of these compounds including insect antifeedant and growth-regulating properties, medicinal effects in humans and other animals, antifungal, bacteriocidal and antiviral activity, are reviewed by Champagne et al. (1992).

The leaves of *Azadirachta excelsa* are used as a green vegetable while the flowers of (male) *Aglaia odorata*, an introduced species, are used to flavour tea. For other local uses, especially in medicine, see Perry (1982). A number of indigenous species are highly ornamental but few are planted. *Aglaia odorata* makes a good, if slow growing, subject for hedging and topiary, which are practised in Java. An admirable example of the imaginative use of Malesian *Meliaceae*, mainly species of *Aglaia, Aphanamixis* and *Dysoxylum* is to be seen in Java around the Lady Raffles Memorial in the Kebun Raya, Bogor. A number of exotics, notably the Indian cultivars of *Melia azedarach* are planted for their elegant foliage and fruits, while the fruits of that species are imported into the Malay Peninsula from Sichuan and used as a febrifuge and vermifuge.

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VERNACULAR NAMES

Because so many of the Malesian *Meliaceae* are not used by the indigenous peoples and because many species from different genera are superficially very similar, there is a great deal of confusion in the literature as well as in the field over the local names. The clearly obvious genera like *Xylocarpus* (nyireh), *Toona* (surian), *Sandoricum* (sentul) or with well known uses as *Lansium* (langsat etc.) have (usually) reliable names. The bulk of the species do not and many of these on herbarium labels and laboriously copied into manuals seem to have been made up on the spot or even to be those used for other trees with pinnate leaves in related families e.g. kedondong (*Burseraceae*). Lantupak is used in northern Borneo for almost any *Meliacea*, as is segera (Iban) in Sarawak, while variations of langsat indicate how the tree in question differs from *Lansium domesticum*. In the Malay Peninsula, bekak is used for some species of *Dysoxylum* and the larger species of *Aglaia*, while pasak lingga is used for species of both of these as well as of *Chisocheton* and *Aphanamixis*. Few vernacular names are indicated here unless there is evidence of use more than once and of their being of some discriminatory value.

KEY TO SUBDIVISION OF THE FAMILY

1a. Buds naked; fruits capsules, berries or drupes; seeds neither corky nor winged ... Subfam. **Melioideae**

b. Buds with scale leaves; fruits woody septifragal capsules with central columella; seeds winged or corky ... Subfam. **Swietenioideae**

The genera are arranged in the tribal system set out by Pennington & Styles (1975). The phytochemical studies since then have not upset it, though have shown how intimately allied are *Trichilieae*, *Guareeae* and *Aglaieae* and drawn attention to the apparently close relationship between *Xylocarpeae* and *Melioideae*.

KEY TO GENERA NATIVE IN MALESIA

(for either flowering or fruiting specimens)

1a. Leaves bipinnate ... **Melia** *(p. 329)*

b. Leaves pinnate to simple ... 2

2a. Leaves all simple (or unifoliolate) ... 3

b. Leaves pinnate to trifoliolate ... 8

3a. Hairs simple only 4
b. Indumentum of at least some stellate hairs and/or stellate or peltate scales 7
4a. Deciduous shrub; fruit a capsule ..... **Turraea** *(p. 24)*
b. Evergreen trees; fruit a berry 5
5a. Anthers in 2 whorls of 5 ..... **Reinwardtiodendron celebicum** *(p. 328)*
b. Anthers in 1 whorl 6
6a. Flowers very small; small tree (Philippines) ... **Walsura monophylla** *(p. 52)*
b. Flowers conspicuous; trees with *Terminalia*-branching ..... **Vavaea** *(p. 34)*
7a. Hairs mixed simple and stellate, suckering shrublets to 1 m .....
..... **Munronia humilis** *(p. 32)*
(see also *Turraea breviflora, p. 29)*
b. Indumentum of stellate hairs and/or stellate or peltate scales; suckers absent ....
..... **Aglaia** *(p. 194)*
8a. Leaves all trifoliolate 9
b. Leaves pinnate 10
9a. Hairs simple ..... **Sandoricum** *(p. 344)*
b. Indumentum of stellate hairs and/or stellate or peltate scales ... **Aglaia** *(p. 194)*
10a. Leaves with pseudogemmula (apical bud) ..... **Chisocheton** *(p. 136)*
b. Leaves without pseudogemmula 11
11a. Leaves with scales and/or stellate hairs 12
b. Leaves with simple hairs 15
12a. Shrublet with large white flowers and capsular fruits .....
..... **Munronia pinnata** *(p. 30)*
b. Trees or treelets 13
13a. Disk present; capsule 5-locular, ± persistent calyx of 5 free sepals; scales absent
..... **Dysoxylum stellatopuberulum** *(p. 73)*
b. Disk absent; fruit different; scales often present 14
14a. Female inflorescence and infructescence long spicate, scales absent .....
..... **Aphanamixis polystachya** *(p. 188)*
b. Not this combination of characters ..... **Aglaia** *(p. 194)*
15a. Budscales present (*Swietenioideae*) 16
b. Budscales absent 18
16a. Leaves (1–)2–4(–5)-jugate, maritime ..... **Xylocarpus** *(p. 371)*
b. Leaves with more leaflets, forest trees 17
17a. Staminal tube present; capsule with 60–100 terminally winged seeds per locule
..... **Chukrasia** *(p. 354)*
b. Stamens free; capsule with many fewer seeds with terminal wings or winged at both ends ..... **Toona** *(p. 358)*
18a. Leaves paripinnate 19
b. Leaves imparipinnate 23

19a. Stigma with conspicuous lobes; fruit a drupe ..... **Azadirachta** *(p. 337)*
b. Stigma unlobed; fruit a capsule or berry 20
20a. Disk absent; fruit a berry 21
b. Disk present; fruit a capsule 22
21a. Anthers in 1 whorl of 10; berries on branches and trunk ... **Lansium** *(p. 314)*
b. Anthers in 2 whorls of 5; berries on axillary infructescences ..... **Reinwardtiodendron** *(p. 322)*
22a. Staminal tube cyathiform ..... **Anthocarapa** *(p. 133)*
b. Staminal tube cylindrical to patelliform ..... **Dysoxylum** *(p. 61)*
23a. Leaf rachis swollen at insertion of leaflets ..... **Walsura** *(p. 45)*
b. Leaf rachis not swollen thus 24
24a. Disk absent; fruit a berry ..... **Pseudoclausena** *(p. 55)*
b. Disk present; fruit a capsule or drupe 25
25a. Stigma with conspicuous lobes; fruit a 1- (or 2-)seeded drupe ..... **Azadirachta** *(p. 337)*
b. Stigma without such lobes; fruit a capsule or drupe with 5 pyrenes 26
26a. Staminal tube deeply cleft; fruit a drupe or 1-seeded capsule 27
b. Staminal tube not deeply cleft; fruit a capsule 28
27a. Corolla valvate; fruit a 5- or 6-pyrened drupe ..... **Cipadessa** *(p. 57)*
b. Corolla imbricate; fruit a 1-seeded capsule ..... **Heynea** *(p. 41)*
28a. Petals 3, disk absent ..... **Aphanamixis** *(p. 187)*
b. Petals 4 or more, disk present ..... **Dysoxylum** *(p. 61)*

SPOT CHARACTERS

Unbranched or sparsely branched pachycaul treelets: *Aglaia, Aphanamixis, Chisocheton, Dysoxylum*
Suckering shrublets: *Munronia, Turraea breviflora*
Bushes: *Turraea, Cipadessa*
Rheophytes: *Aglaia, Dysoxylum angustifolium, Sandoricum borneense*
Halophytes: *Xylocarpus*
Bark with white latex: *Aglaia, Chisocheton, ?Dysoxylum*
Budscales present: *Swietenioideae*
Budscales absent: *Melioideae*
Indumentum of or with stellate hairs: *Aglaia, Aphanamixis polystachya* (sometimes), *Chisocheton* sect. *Rhetinosperma, Dysoxylum stellatopuberulum, Melia*
Indumentum of stellate or peltate scales: *Aglaia*
Leaves opposite: *Dysoxylum*
Leaves simple or unifoliolate: *Aglaia, Munronia, Turraea breviflora, Vavaea, Walsura monophylla*

Leaves trifoliolate: *Aglaia, Sandoricum*
Leaves imparipinnate: *Aglaia, Aphanamixis, Azadirachta, Chisocheton, Cipadessa, Dysoxylum, Heynea, Pseudoclausena, Walsura*
Leaves paripinnate (sometimes a lateral leaflet pseudoterminal): *Anthocarapa, Azadirachta, Chisocheton, Chukrasia, Dysoxylum, Reinwardtiodendron, Toona, Xylocarpus*
Leaves bipinnate: *Melia*
Leaves with terminal bud (pseudogemmula): *Chisocheton*
Inflorescences epiphyllous: *Chisocheton*
Inflorescences cauliflorous: *Chisocheton, Dysoxylum, Lansium*
Inflorescences ramiflorous: *Aglaia, Chisocheton, Dysoxylum, Lansium*
Inflorescences flagelliflorous: *Aphanamixis, Chisocheton, Dysoxylum*
Flowers yellow: *Aglaia*
Sepals free, in a spiral: *Dysoxylum*
Sepals leafy: *Munronia*
Calyx deeply lobed with almost free orbicular sepal lobes: *Aphanamixis, Lansium, Reinwardtiodendron*
Calyx valvate: *Xylocarpus*
Petals in a spiral, sometimes appearing as 2 whorls: *Chisocheton*
Corolla valvate: *Chisocheton, Cipadessa, Dysoxylum, Walsura*
Petals 3: *Aglaia, Aphanamixis, Chisocheton* (rare), *Vavaea, Dysoxylum* (rare)
Filaments free: *Toona, Walsura* sect. *Surwala*
Staminal tube globose: *Aglaia, Aphanamixis, Lansium, Reinwardtiodendron*
Anthers in 2 or more whorls: *Aglaia* (rare), *Reinwardtiodendron*
Anthers locellate: *Chisocheton, Dysoxylum*
Disk absent: *Aglaia, Aphanamixis, Lansium, Munronia, Reinwardtiodendron, Vavaea*
Disk tubular: *Dysoxylum, Sandoricum*
Fruit a loculicidal capsule: *Aglaia, Anthocarapa, Aphanamixis, Chisocheton, Dysoxylum, Heynea, Munronia, Turraea*
Fruit a septifragal capsule: *Swietenioideae, Walsura dehiscens*
Fruit a berry: *Aglaia, Lansium, Pseudoclausena, Reinwardtiodendron, Vavaea, Walsura*
Fruit a drupe: *Azadirachta, Cipadessa, Melia, Sandoricum*
Seeds winged: *Chukrasia, Toona*
Seeds corky: *Xylocarpus*

Subfamily MELIOIDEAE

Melioideae; T.D. Penn., Blumea 22 (1975) 451.

Buds naked. Plants dioecious, polygamous or with hermaphrodite flowers entirely. *Locules* 1-, 2- or 3-ovular with vestigial third ovule, very rarely multiovulate; ovules collateral or superposed. *Fruit* a fleshy or leathery capsule, berry or drupe. *Seeds* unwinged, usually with a fleshy testa or aril or combination of these; endosperm present or absent.

Seven tribes, pantropical.

Tribus Turraeeae

Turraeeae Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 267, 280; T.D. Penn., Blumea 22 (1975) 451.

Aitonieae Harv., Gen. S. Afr. Pl. (1838) 46, sub *Zygophyllaceae*, nom. illeg.; M. Roem., Synops. Monogr. 1 (1846) 78, 88; Baill., Hist. Pl. 5 (1874–75) 426, sub *Sapindaceae*. — *Aitoniaceae* (Harv.) Harv., Fl. Cap. 1 (1860) 243 ('*Aitonieae*'); Airy Shaw, Willis Dict. Flow. Pl. Ferns, ed. 7 (1966) xxi.

Trees, shrubs or suffrutices. *Indumentum* of simple or stellate hairs. *Leaves* pinnate, trifoliolate or simple. *Flowers* hermaphrodite or very rarely apparently dioecious. *Staminal tube* complete, cylindrical or filaments united only in lower half (not in Malesia). *Disk* absent or feebly developed. *Stylehead* often modified to form 'receptaculum pollinis'. *Fruit* a capsule (Malesia); seed endospermous. *Cotyledons* flat, collateral; radicle superior, exserted.

Distribution — Six or seven genera restricted to the Old World tropics. The largest is the viable *Turraea*, which is most widespread and the rest are satellite genera, one or two restricted to Indomalesia, two to Madagascar, one to southern Africa and one found in both India and southern Africa.

TURRAEA

Turraea L., Mant. Alt. (1771) 150; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 85, t. 20; T.D. Penn., Blumea 22 (1975) 455, f. 3 (see there for extra-Malesian synonyms); Mabb. & Cheek, Taxon 41 (1992) 541.

Small trees or shrubs. *Indumentum* of simple hairs. *Leaves* simple (pinnate in one African species), entire or (not in Malesia) sometimes sinuate or crenate. *Inflorescences* axillary, fasciculate, cymose or paniculate, or flowers solitary (terminal or ramiflorous outside Malesia). *Flowers* bisexual, greenish or white. *Calyx* (3–)4–5(–6)-lobed or -toothed. *Petals* (3) 4 or 5, free, imbricate or contorted. *Staminal tube* cylindrical or rarely (not in Malesia) cyathiform, complete or filaments at least 2/3 united; margin shallowly lobed or entire (not in Malesia) or terminated by simple or bilobed appendages, as many as or twice as many as the anthers; anthers (7–)8–10(–20). *Disk* small or absent. *Ovary* (3–)4–10(–20)-locular; locules biovulate; style usually expanded near apex forming a 'receptaculum pollinis' surmounted by a discoid stigmatic area. *Fruit* a (3–)4–10(–20)-

valved, loculicidal capsule; locules 1- or 2-seeded. *Seeds* plano-convex, raphe-funicular-arillate; embryo embedded in thick endosperm, with rather narrow cotyledons.

Distribution — About 30 species in Africa, perhaps 35 in Madagascar and the Mascarenes with one in Indomalesia, extending from India, through *Malesia* to tropical Australia.

Habitat & Ecology — The African species are found in a variety of forest types and bush vegetation, often markedly seasonal.

Turraea pubescens Hell.

Turraea pubescens Hell., Kon. Vet. Acad. Nya Handl. 9 (1788) 308, t. 10 f. 3; Willd., Sp. Pl. 2 (1799) 555; J.E. Smith in Rees, Cyclop. 36, 2 (1817) Turraea n. 2; DC., Prodr. 1 (1824) 620; G. Don, Gen. Syst. 1 (1831) 678; Benn., Pl. Jav. Rar. (1840) 181; M. Roem., Synops. Monogr. 1 (1846) 91; Miq., Fl. Ind. Bat. 1, 2 (1859) 534; F. Muell., Essay Pl. Fitz. (1860) 5; Fragm. Phyt. Austral. 5 (1866) 144; Descr. Not. Pap. Pl. 4 (1876) 53; Benth., Fl. Austral. 1 (1863) 379; C.DC. in DC., Monogr. Phan. 1 (1878) 446; Hance, J. Bot. 16 (1878) 9; Vidal, Rev. Vasc. Pl. Filip. (1886) 81; Forbes & Hemsl., J. Linn. Soc., Bot. 23 (1886) 113; F.M. Bailey, Proc. Roy. Soc. Queensl. 1 (1884) 63; Moore, Handb. Fl. NSW (1893) 37; F.M. Bailey, Queensl. Fl. 1 (1899) 226; Pellegr. in Fl. Indo-Chine 1 (1911) 735, t. 80, f. 5–12; Suppl. (1946) 687, incl. var. *billardierei* (DC.) Pellegr. ('*billardieri*'); Koord., Exk. Fl. Java 2 (1912) 438; F.M. Bailey, Compreh. Catal. Queensl. Pl. (1913) 86, t. 72; Craib, Fl. Siam. Enum. 1 (1926) 249, incl. var. *billardierei*; Merr., Lingn. Sc. J. 5 (1927) 103; How & Chen, Acta Phytotax. Sin. 4 (1955) 4; Backer & Bakh. f., Fl. Java 2 (1965) 191; Chun, Fl. Hain. 3 (1974) 60; T.D. Penn., Blumea 22 (1975) 456, f. 3b; Corner, Seeds Dicots (1976) 192, t. 392; Taylor & Harden, Flora NSW 2 (1991) 282; Hô, Ill. Fl. Vietnam 2, 1 (1992) 484.

Turraea virens L. var. *billardierei* DC., Prodr. 1 (1824) 620 ('*billardierii*'); G. Don, Gen. Syst. 1 (1831) 678. — *Turraea billardierei* (DC.) A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 218 ('*billardierii*'); Benn., Pl. Jav. Rar. (1840) 181; M. Roem., Synops. Monogr. 1 (1846) 92; Miq., Fl. Ind. Bat. 1, 2 (1859) 534; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 4; C.DC. in DC., Monogr. Phan. 1 (1878) 440 ('*billiardieri*'); Backer, Schoolfl. (1911) 201; de Voogd, Trop. Nat. 25 (1927) 167, t. 5.

Turraea virens auct. non L.: J. Graham, Cat. Pl. Bombay (1839) 31; M. Roem., Synops. Monogr. 1 (1846) 92; Dalz. & Gibs., Bomb. Fl. (1861) 36; Drury, Handb. 1 (1864) 169; Hiern in Hook. f., Fl. Brit. India 1 (1875) 541 p.p.; Talbot, Trees Bomb. (1894) 38 & ed. 2 (1902) 72.

Turraea villosa Benn., Pl. Jav. Rar. (1840) 182; M. Roem., Synops. Monogr. 1 (1846) 92; Wight, Ic. 4, 4 (1850) t. 1593; Drury, Handb. 1 (1864) 169; Hiern in Hook. f., Fl. Brit. India 1 (1875) 542; C.DC. in DC., Monogr. Phan. 1 (1878) 442; Talbot, Trees Bomb. (1894) 38 & ed. 2 (1902) 72; Cooke, Fl. Bomb. 2 (1902) 214; Brandis, Indian Trees (1906) 134; Talbot, For. Fl. Bomb. 1 (1909) 224, t. 134; Gamble, Fl. Madras 1 (1915) 174; Basu, Ind. Med. Pl. (1918) 298, t. 216; Anon., Wealth of India 10 (1976) 397.

Turraea concinna Benn., Pl. Jav. Rar. (1840) 182; M. Roem., Synops. Monogr. 1 (1846) 92; Miq., Fl. Ind. Bat. 1, 2 (1859) 534; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 4; C.DC. in DC., Monogr. Phan. 1 (1878) 441; Backer, Schoolfl. (1911) 201; Koord., Exk. Fl. Java 2 (1912) 438.

Turraea zollingeri C.DC. in DC., Monogr. Phan. 1 (1878) 441.

Turraea indica C.DC., op. cit. (1878) 439.

Turraea brownii C.DC., op. cit. (1878) 442; Domin, Bibl. Bot. 22 (1927) 852; Brouwer, Fl. Males. Bull. 32 (1979) 3244; Stanley & Ross, Fl. SE Queensl. 1 (1983) 477.

Turraea membranacea Merr., Philipp. J. Sc., Bot. 9 (1914) 306; Enum. Philipp. Flow. Pl. 2 (1923) 359.

Deciduous shrub often of straggling habit, or, more rarely, a small tree to 6 m; trunk to 11 cm dbh. Bark silvery grey to reddish, sometimes with prominent lenticels; inner bark fawn, with sickly smell; sapwood creamy yellow. Leafy *twigs* 2–3 mm diam.

Fig. 1. *Turraea pubescens* Hell. a, b. Habit, flowering; c. half flower; d. habit, fruiting; e. seeds (a–c: *Womersley NGF 19133*; d, e: *Mabberley 1778*). Drawing R. Wise.

Leaves 1.5–10(–17) by 1–6 cm, often not completely expanded at anthesis, ovate to oblong, subglabrous or sparsely hairy on veins to subvelutinous adaxially; apex obtuse to acuminate; base rounded to cuneate; major veins c. 5 or 6 on each side, acute, arcuate, very occasionally with tufts of hairs in their axils; petiole 5–9 mm. *Inflorescences* fascicles or condensed cymes of up to 6 sweetly scented flowers, sometimes produced on leafless branches; axis 2–5 mm long, pubescent; bracts 1–2 mm long, triangular, pubescent; pedicels 1.5–3 cm. *Calyx* 3–4 mm long, cupular, 5-lobed up to halfway down, pubescent. *Petals* 30–45 by 2.5–4 mm at widest, linear-spathulate, white becoming yellowish with age. *Staminal tube* 20–30 by c. 3 mm at widest, cylindrical to weakly obconical, white, margin subentire or, usually, with ten appendages sometimes divided apically into 2(–4) lobes, reflexed at anthesis; anthers 10, c. 1 mm long, at apex of tube, glabrous, yellow, filament very short. *Ovary* 5-locular, subglabrous; style c. 30–45 mm, long-exserted, ± pubescent in proximal region, stylehead expanded to form a 'receptaculum pollinis', surmounted by discoid stigmatic region pale yellow. *Fruits* up to 1.8 cm long, globose to subellipsoid, vermilion, 5-sutured, the 5 leathery valves reflexed at dehiscence starwise, 1–5 each bearing two seeds. *Seeds* c. 6 mm long, arillate; testa black, shiny; aril scarlet; endosperm slightly elongate. — **Fig. 1.**

Distribution — Indomalesia from India and S China to tropical Australia, south to northern New South Wales; in *Malesia:* Java, Philippines (Luzon), Lesser Sunda Islands (Flores, Timor), New Guinea.

Habitat — Semi-evergreen and deciduous forest to 1000 m altitude but usually much lower, and in coastal vegetation, behind mangrove, on dunes or rocks including limestone and basalt, as well as secondary vegetation at forest edges and on ridges, in vine thickets and *Eucalyptus* savanna.

Ecology — The species flowers at the onset of the rains, when it may be leafless and then it is a conspicuous feature, as is *Munronia pinnata* of the spring flora of the teak forests of E Java. The scented white flowers with the long style suggest moth-pollination which is recorded in allied species from Africa.

Uses — The plant is of some slight medicinal value in India [see Wealth of India 10 (1976) 397]. There its pickled fruits are used as a dye. Corner (l.c.) notes that a reddish-purple coloration is imparted to potash solution in which seeds have been steeped.

Notes — 1. *Turraea pubescens* is the only true *Turraea* in Asia and is closely related to some of the East African species. A similar transoceanic distribution is seen in the allied *Naregamia* Wight & Arn. [see Cheek, Kew Bull. 45 (1990) 711], which comprises one species in India and a very closely related one in Angola.

2. As Bentham (l.c.) noted, the staminal tube appendages, on which character several 'species' were segregated, vary greatly, even on one flowering shoot. The degree of pubescence also varies and may be associated with the level of exposure while shape of stylehead varies with development and between flowers on the same plant. Immature fruits dehisce on drying so the 'ripe' fruit size appears to vary greatly in herbarium material.

3. Seeds of *T. pubescens* have been examined by Corner (l.c.), who regards them as very similar to those of *Celastraceae*, to which family many collectors have assigned fruiting material of this species in the field.

Fig. 2. *Turraea breviflora* Ridley. a. Habit; b. half flower. Drawing R. Wise.

SPECIES TO BE EXCLUDED FROM TURRAEA

Turraea breviflora Ridley

Turraea breviflora Ridley, Fl. Malay Penins. 1 (1922) 383; J. As. Soc. Str. Br. 86 (1922) 293; Henderson, J. Roy. As. Soc. Mal. Br. 17 (1939) 40; T.D. Penn., Blumea 22 (1975) 458; Mabb. in Tree Fl. Malaya 4 (1989) 252.

Suckering shrublet to 1 m tall, making stands of branching stems of 6 mm diam.; taproots long, tenacious. *Indumentum* of stellate hairs with some simple ones. Leafy *twigs* 2–3 mm diam., densely pubescent. *Leaves* distichously arranged, 12–20 by 4–5 cm, elliptic to weakly obovate, somewhat bullate, subglabrous, pale abaxially; apex gradually long-acuminate; base acute to cuneate; venation prominent on both surfaces in sicco, midrib sparsely pubescent proximally, major veins 7–10 on each side, arcuate and looped at margin. *Flowers* in 3–6-flowered fascicles or cymes, in axils of leaves present or lost; branches 2–4 mm long, pubescent; pedicels 4–9 mm long, pubescent. *Calyx* c. 2–3 mm tall, very shallowly cupulate, 5-lobed, pubescent, green, the lobes triangular to 1.5 mm long. *Petals* 5, 6–7 by 2–3 mm, narrowly ovate, valvate, reflexed at anthesis, white. *Staminal tube* a little shorter than petals, white, bearing 10 filiform appendages alternating with anthers; anthers 10 with apical appendage. *Disk* cupuliform, short, closely encircling ovary, margin somewhat erose. *Ovary* 5-locular, each locule 1-ovular, or, rarely, apparently 3-locular and some locules 2-ovular, pubescent with upward-pointing simple hairs; style c. 5 mm, pubescent; stylehead capitate, 5-lobed, orange. *Fruit* not observed. — **Fig. 2.**

Distribution — *Malesia:* known only from a few localities in the Malay Peninsula (Selangor, Johore) and Singapore.

Habitat & Ecology — Recorded from rather open hill Dipterocarp forest, often associated with bertam, *Eugeissona tristis*, and from limestone rocks (Ridley, Henderson).

Note — This plant resembles no other Malesian *Meliacea* and, in the field, may be readily confused with *Icacinaceae* or other families. It is known from very well-worked sites such as Bukit Lagong and Ulu Gombak in Selangor but has never been found in fruit and the number of flowering collections made is small. No doubt it is frequently overlooked as it grows amongst tree seedlings and saplings which it greatly resembles. Ridley placed it in *Turraea* as it seemed the closest genus to him but he was hesitant and thought it might represent a new genus, though refrained from describing it as such until the fruit should be found. Harms placed it near the *Turraea* species of the Mascarenes formerly referred to the separate genus, *Quivisia*. It is to be excluded from *Turraea* because it differs in its habit, indumentum, corolla aestivation, disk and the usual number of ovules in each locule, while it seems to be dioecious. In its indumentum, it approaches *Munronia* to which genus it seems on the whole more closely allied, but it differs from that genus, as presently understood, in its habit, valvate corolla, the usual number of ovules in each locule and apparent dioecy. In short, either it represents an undescribed genus or our concept of *Munronia* must be enlarged.

MUNRONIA

Munronia Wight, Ic. 1, 5 (1838) [1]; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 91; T.D. Penn., Blumea 22 (1975) 452.
[*Aengelenia* Hassk., Cat. Bogor. Pl. (1844) 219, nom. in syn.]
Philastrea Pierre, Bull. Mens. Soc. Linn. Paris 1 (1885) 475.

Unbranched or sparsely branched shrublets, sometimes suckering with apparently short-lived shoots. *Indumentum* a mixture of simple and bifid or stellate hairs. *Leaves* simple to imparipinnate, often crenate to serrate. *Flowers* hermaphrodite, solitary or in few-flowered thyrses, pseudopedicellate, usually white. *Calyx* 5-lobed to near base, lobes somewhat foliaceous. *Petals* 5, imbricate, adnate to staminal tube basally, rarely becoming free later. *Staminal tube* narrowly cylindrical or weakly obconical, the margin with 10 entire or bilobed appendages or, rarely, with 10 reflexed filiform appendages recurved some distance below margin; anthers 10, pubescent, inserted on tube rim, alternating with appendages, connective often produced apically forming an appendage, which is rarely filiform. *Disk* absent or tubular, free or united with base of staminal tube. *Ovary* 5-locular, each locule with two superposed ovules; stylehead capitate, sometimes with 5 stigmatic lobes. *Fruit* a 5-valved loculicidal capsule, each locule with 1 or 2 seeds. *Seeds* plano-convex with a bony tegmen with an outgrowth enveloping a thick sarcotesta (Cheek); embryo embedded in thin endosperm.

Distribution — About 6 species restricted to tropical Asia and subtropical China, two of them extending into *Malesia*, eastwards to Timor.

Habitat — Drier forests up to about 900 m altitude (Lesser Sunda Islands).

Note — *Turraea breviflora* Ridley (q.v.) may be referable here also.

KEY TO THE SPECIES

1a. Leaves pinnate ..... **1. M. pinnata**
b. Leaves simple ..... **2. M. humilis**

1. Munronia pinnata (Wall.) Theob.

Munronia pinnata (Wall.) Theob. in Mason, Burma, ed. 4, 2 (1883) 581; Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 78; Rao, Bull. Bot. Surv. India 5 (1963) 255, t. 1; Sald. & Nicols., Fl. Hassan Distr. (1976) 395; Whitmore, Enum. Flow. Pl. Nepal 2 (1979) 85; Stone, Malay. Nat. J. 37 (1984) 189; Mabb. in Tree Fl. Malaya 4 (1989) 202. — *Turraea pinnata* Wall., Pl. As. Rar. 2 (1830) 21, t. 19; Lindl., Bot. Reg. 17 (1831) t. 1413; G. Don, Gen. Syst. 1 (1831) 678; Span. — [*Munronia wallichii* Wight, Ill. 1 (1840) 147, nom. superfl.; Benn., Pl. Jav. Rar. (1840) 185; M. Roem., Synops. Monogr. 1 (1846) 91; Drury, Handb. 1 (1864) 168; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 5; Hiern in Hook. f., Fl. Brit. India 1 (1875) 543; C.DC. in DC., Monogr. Phan. 1 (1878) 449; Gamble, Fl. Madras 1 (1915) 175.]
[*Melia pumila* Moon, Cat. (1824) 35, nom. nud.] — *Munronia pumila* Wight, Ic. (1839) t. 91; Illust. 1 (1840) 146; M. Roem., Synops. Monogr. 1 (1846) 91; Hiern in Hook. f., Fl. Brit. India 1 (1875) 543; C.DC. in DC., Monogr. Phan. 1 (1878) 448, t. 6, f. 8; Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 77.
Turraea pinnata Span., Comp. Bot. Mag. 1 (1836) 345, nom. nud.; Linnaea 15 (1841) 183; M. Roem., Synops. Monogr. 1 (1846) 92; Miq., Fl. Ind. Bat. 1, 2 (1859) 534; non Wall. (1830).

Munronia neilgherrica Wight, Illust. 1 (1840) 147, t. 54; Drury, Handb. 1 (1864) 167; M. Roem., Synops.. Monogr. 1 (1846) 91.

Munronia javanica Benn., Pl. Jav. Rar. (1840) 176, 185, t. 38; Hassk., Pl. Rar. Hort. Bogor., Pug. Nov. (1844) 11 ('*javana*'); Pl. Jav. Rar. (1848) 281; M. Roem., Synops. Monogr. 1 (1846) 91; Moore, Gard. Comp. Flor. Guide (1852) 121 cum ic.; Lem., Jard. Fleur. 4 (1853) t. 360; Miq., Fl. Ind. Bat. 1, 2 (1859) 535; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 4; C.DC. in DC., Monogr. Phan. 1 (1878) 448; Backer, Schoolfl. Java (1911) 201; Koord., Exk. Fl. Java 2 (1912) 438; Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 79; de Voogd, Trop. Nat. 15 (1927) 167, t. 3, 4; Backer & Bakh. f., Fl. Java 2 (1965) 119.

[*Ebermaiera pulchella* Zipp. ex Span., l.c., nom. in syn. ('*Ebermeyera*').]

Didymocheton littorale Hassk., Tijds. Nat. Gesch. 10 (1843) 138; Cat. Pl. Bogor. (1844) 219; M. Roem., Synops. Monogr. 1 (1846) 105.

[*Didymocheton pumilum* Blume ex Miq., l.c., nom. in syn.]

[*Trichilia humilis* Zipp. ex Miq., l.c., nom. in syn.]

Munronia timoriensis Baill., Adansonia 11 (1874) 266; C.DC. in DC., Monogr. Phan. 1 (1878) 499; Bot. Jahrb. 7 (1886) 461; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 158 E; ed. 2, 19bl (1940) t. 21 E, F.

Unbranched or sparsely branched shrublet to 65 cm tall. *Stem* to 7 mm diam., flexuous; rooting system with a taproot or up to five major tough roots. Bark finely fissured. Leafy shoots cicatrose, the leaves forming an apical rosette. *Indumentum* of vegetative parts a mixture of simple and bifid or sometimes stellate distally-pointing hairs, most dense on innovations. *Leaves* imparipinnate, to 26 cm long; petiole 1.5–5.5 cm, ± terete, pubescent. *Leaflets* (3, 5) 7 or 9 (11), the apical the largest, to 9 by 4 cm, ovate to obovate or subrhomboidal, the most proximal the smallest, to c. 4 by 2 cm, oval to orbicular, scattered stellate-pubescent adaxially, with denser mixed simple and bifid hairs abaxially, esp. on veins, or both surfaces thus, apex acute to acuminate; base asymmetric, cuneate in apical leaflet to rounded or subcordate in most proximal; margin entire to ± dentate, serrate or even lobed halfway to midrib in distal half; petiolule to 1.5 cm on apical leaflet, 0–4 mm elsewhere; nerves c. 4 on each side, arcuate, sometimes anastomosing well away from margin. *Thyrses* 2.5–15(–25) cm long, pubescent with up to 25 flowers, opening a few at a time, sometimes scented, pedicels 1–2 mm, densely hairy; bracts c. 2.5 mm long, subulate or narrowly triangular, densely hairy. Pseudopedicel c. 5 mm long, pubescent. *Calyx* lobes 5–7 mm long, spatulate, patent, pubescent on both surfaces. *Corolla* white, tube (10–)12–17 mm long, lobes 10–18 mm long, spatulate, 6–7 mm wide at broadest, acute, hairy abaxially; midvein conspicuous. *Staminal tube* free for apical 6–10 mm, simple hairy within (and sometimes without), margin with 10 entire appendages reflexed at anthesis; anthers yellow-brown, with short apical appendices. *Disk* 2–3 mm tall, cylindrical to conical, finely simple hairy. *Ovary* finely simple-hairy; style simple-hairy in proximal half, stylehead yellow-brown. *Capsule* c. 1–1.2 cm diam., depressed-globose, strongly 5-ribbed, sparsely stellate-hairy. *Seeds* brown.

Distribution — Tropical Asia from India, Sri Lanka and eastern Himalaya to Thailand and *Malesia:* Langkawi, Java, Lesser Sunda Islands (Bali, Sumba, Flores, Solor, Timor). Cultivated under glass in Europe.

Habitat & Ecology — Altitude 0–900 m. Seasonal forests including those on limestone and just behind the mangrove as well as the Javanese teak forests, where, like

Turraea pubescens, it is conspicuous when in flower in the spring, reminiscent of an *Anemone* (*Ranunculaceae*) in Europe according to De Voogd. In some parts of its range, notably Sri Lanka, it is heavily overcollected (see Uses below) and in that island, most remaining accessible specimens are small precociously flowering plants with few leaflets and flowers.

Vernacular names — Godong lema (Jav.), singadepo laut (Sund.), Java; boan (Dawan), Timor.

Uses — *Munronia pinnata* is used in Ayurvedic medicine as a substitute for chiretta (*Swertia* spp., *Gentianaceae*) in the treatment of fevers and dysentery; of all native plant drugs in Sri Lanka it commands the highest price and has been used in the treatment of leprosy and other skin diseases. The whole plant is uprooted and dried to give the commercial materia medica. *Andrographis paniculata* (Burm. f.) Nees (*Acanthaceae*) is, in turn, used as a cheaper substitute for *M. pinnata*.

Note — The description is that of Malesian material, in which there is very interesting variation, somewhat correlated with geography but not sufficiently clearly so for the recognition of formal infraspecific taxa based on the currently available evidence. Some plants from Timor are robust with 9 large entire or subentire leaflets and large flowers in short few-flowered inflorescences and thus resembling plants from India. Others are less robust, with more lobed leaflets and longer inflorescences, more closely resembling the bulk of the material from Java. Some specimens from that island, though, resemble the Indian plants while most of the specimens from Flores are rather delicate plants with much-lobed leaflets. The single specimen from Langkawi has the foliage of Indian specimens but the longer inflorescence more typical of the Javanese plants.

2. **Munronia humilis** (Blanco) Harms

Munronia humilis (Blanco) Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 80; in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 22; Pellegr. in Fl. Indo-Chine., Suppl. (1946) 688. — *Plagianthus humilis* Blanco, Fl. Filip. (1837) 526; ed. 2 (1845) 367; ed. 3, 2 (1878) 315, t. 181. — *Turraea humilis* (Blanco) Merr., Philipp. Govt. Lab. Bur. Bull. 27 (1905) 30; Fl. Manila (1912) 274; Philipp. J. Sc., Bot. 9 (1914) 308; Sp. Blanc. (1918) 208; Enum. Philipp. Flow. Pl. 2 (1923) 359; Craib, Enum. Fl. Siam. 1 (1926) 248; Adelb., Blumea 6 (1948) 315; Backer & Bakh. f., Fl. Java 2 (1965) 119.

Turraea pumila Benn., Pl. Jav. Rar. (1840) 183; Miq., Fl. Ind. Bat. 1, 2 (1859) 534; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 4; C.DC. in DC., Monogr. Phan. 1 (1878) 440; Fern.-Vill., Fl. Filip. Nov. App. (1880) 41; Vidal, Rev. Pl. Vasc. Filip. (1886) 81; Backer, Schoolfl. Java (1911) 200; Koord., Exk. Fl. Java 2 (1912) 438.

?*Turraea zollingeri* C.DC. in DC., Monogr. Phan. 1 (1878) 441; ?Backer, Schoolfl. Java (1911) 200; ?Koord., Exk. Fl. Java 2 (1912) 438.

Turraea palawanensis Merr., Philipp. J. Sc., Bot. 9 (1914) 307; Enum. Philipp. Flow. Pl. 2 (1923) 359; Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 80. — *Munronia palawanensis* (Merr.) Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 80; in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 93.

Munronia pseudoturraea Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 79.

Suffrutex with apparently short-lived semi-herbaceous shoots to 30 cm, but usually much less, and a woody stock to 8 mm diam. *Aerial shoots* unbranched or sparsely branched, 2–3 mm diam., leafy throughout. *Indumentum* of simple and stellate hairs.

Fig. 3. *Munronia humilis* (Blanco) Harms. a. Habit; b, c. half flower; d. detail androecium; e. fruit; f, g. seeds (a, e–g: *Maxwell 75-239*; b–d: *Ramos 14994*). Drawing R. van Crevel.

Leaves simple, 3.5–8 by 1–4 cm, ovate or obovate, finely simply hairy especially on abaxial venation; apex acute or obtuse; base cuneate to decurrent; margin dentate or sinuately lobed, predominantly in more distal half; veins about 4 or 5 on each side, ascending, culminating in tips of major lobes; petiole 5–20 mm, pubescent. *Flowers* solitary or, more usually, in few-flowered thyrses up to 18 mm long, axillary to somewhat supra-axillary, squarrose, pubescent; bracts c. 4 mm long, subulate, pubescent; bracteoles c. 1 mm long, long-triangular, pubescent. Pseudopedicels 6–9 mm long, pubescent. *Calyx* lobes 5–7 mm long, subulate, shortly hairy. *Petals* 2.75–4 cm long, 3–4 mm wide, linear-spatulate, white, cohering at base, apex acute. *Staminal tube* narrowly conical, white, with the filaments reflexed and curved outward at tips to form a subapical ruff; anthers at resultant apex, orange. *Disk* absent. *Ovary* subglabrous; stylehead 5-lobed, orange-yellow. *Fruit* c. 1 cm, depressed globose, lobed, subglabrous. — **Fig. 3.**

Distribution — Thailand and *Malesia:* Java, Philippines (Palawan, Luzon).

Habitat — Seasonal forest including bamboo (Thailand) and that on limestone, thickets, open ravines and crevices in limestone rocks, 20–400 m altitude.

Notes — 1. This species constitutes sect. *Pseudoturraea* Harms, characterized by the reflexed staminal tube appendages and the petals free from the tube. The third section, *Philastrea* (Pierre) Harms, is also monotypic but restricted to Indochina. The status of these sections cannot be evaluated in the absence of a modern revision of the genus.

2. The habit of *Munronia humilis* superficially resembles that of *Hippobroma* (*Laurentia, Isotoma*) *longiflora* (L.) G. Don (*Campanulaceae*).

Tribus Vavaeeae

Vavaeeae Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 286; T.D. Penn., Blumea 22 (1975) 464.

Trees or treelets with sympodial ('*Terminalia*'-)branching. *Indumentum* of simple hairs. *Leaves* simple. *Flowers* mostly hermaphrodite. *Staminal tube* cylindrical or cyathiform; filaments partly free. *Disk* obscure or absent. *Ovary* locules 1–multi-ovulate. *Fruit* a berry. *Seeds* with thin sarcotesta; thin endosperm sometimes present; cotyledons plano-convex, collateral.

Monotypic.

VAVAEA

Vavaea Benth. in Hook. Lond. J. Bot. 2 (1843) 212; T.D. Penn., Blumea 17 (1969) 351; Blumea 22 (1975) 464.

Lamiofrutex Laut., Nova Guinea 14 (1924) 147; Engl. in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19a (1931) 330 (sub *Rutaceae*).

Calyx 4- or 5(–7)-lobed, with open rarely imbricate aestivation. *Petals* (3–)4–6, free, imbricate, rarely contorted. *Filaments* united in at least the proximal half; anthers 9–23, attached at ends of filaments. *Disk* patelliform or cyathiform, united to base of tube, or

forming androecial ribbing, or absent. *Ovary* 2–6-locular, locules with 1 or with 2 (3) collateral ovules or with 4–10 in 2 rows. *Berry* with fleshy to woody pericarp. *Seeds* 1–3(–7), ovoid or plano-convex; radicle superior, small, included or extending to the surface. Germination cryptocotylar, cophylls opposite, simple.

Distribution — Four species from Sumatra eastwards through *Malesia* to tropical Australia, Micronesia, Melanesia and Polynesia, one restricted to Fiji and two to New Guinea.

Divisible into two sections of two species each.

KEY TO THE SPECIES

1a. Petals 4–9.5 mm; staminal tube 2–5.5 mm, barbate at throat; anthers 0.3–1.2 mm long; locules 1- or 2- (or 3-)ovulate ..... **1. V. amicorum**

b. Petals 35–80 mm, staminal tube 35–67 mm, not barbate at throat; anthers 2.5–6.5 mm long; locules 4–10-ovulate (sect. *Grandiflorae*) 2

2a. Calyx persistent in fruit; petals 4; staminal tube glabrous or rarely sparsely hairy without; filaments united to about halfway; ovary 4-locular; berry 12–18 mm, with thin soft pericarp ..... **2. V. papuana**

b. Calyx not persistent in fruit; petals 5 (6); staminal tube densely appressed hairy without; filaments united to near apex, the free tips 5–9 mm; ovary 5- or 6-locular; berry 23–30 mm, with thick hard pericarp ..... **3. V. tubiflora**

Section Vavaea

Vavaea sect. *Vavaea*; T.D. Penn., Blumea 17 (1969) 358.

Petals 4–9.5 mm. *Staminal tube* 2–5.5 mm, cyathiform or shortly tubular, barbate at throat; anthers 9–17, 0.3–1.2 mm; pollen grains 45–80 µm long, ora lalongate. *Ovary* locules 1- or 2- (or 3-)ovulate.

Distribution — Two species, the range of the genus, one in *Malesia*, the other, *V. megaphylla* Wright, restricted to Fiji.

1. Vavaea amicorum Benth.

Vavaea amicorum Benth. in Hook. Lond. J. Bot. 2 (1843) 212; M. Roem., Synops. Monogr. 1 (1846) 141; Walp., Rep. 5 (1846) 377; A. Gray, U.S. Expl. Exped. Bot. Phan. 1 (1854) 244, t. 16, f. B; Mem. Amer. Acad. Arts Sci. n.s. 5 (1855) 329; C. Muell. in Walp., Ann. 4 (1857) 388; C.DC. in DC., Monogr. Phan. 1 (1878) 645; Bot. Jahrb. 7 (1886) 461; Hemsl., J. Linn. Soc., Bot. 30 (1894) 171; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 158, f. J, K; ed. 2, 19b1 (1940) t. 21, f. J, K; Burkill, J. Linn. Soc., Bot. 35 (1901) 31; C.DC., Nova Guinea, Bot. 8 (1910) 426; Merr., Philipp. J. Sc., Bot. 13 (1918) 301; Enum. Philipp. Flow. Pl. 2 (1923) 359; Elmer, Leafl. Philipp. Bot. 9 (1937) 3390; A.C. Smith, Contr. U.S. Nat. Herb. 30 (1952) 472; T.D. Penn., Blumea 17 (1969) 358, f. 1a–e; Blumea 22 (1975) 465, f. 5a.

Vavaea harveyi Seem., Fl. Vit. (1865) 35; C.DC. in DC., Monogr. Phan. 1 (1878) 646; A.C. Smith, Contr. U.S. Nat. Herb. 30 (1952) 473.

Vavaea vitiensis Seem., Fl. Vit. (1865) 35.
Vitex bantamensis Koord. & Valeton, Bijdr. Booms. Java 7 (1900) 210; Koord., Exk. Fl. Java 3 (1912) 137; Atlas 2 (Feb. 1914) t. 298. — *Vavaea bantamensis* (Koord. & Valeton) Koord. & Merr. in Koord., Atlas 2, err. slip t. 298 (Apr. 1914); Backer & Bakh. f., Fl. Java 2 (1965) 120.
Vavaea pauciflora Volk., Bot. Jahrb. 31 (1901) 465; Kaneh., Bot. Mag. Tokyo 45 (1931) 289; Fl. Micron. (1933) 165; J. Dept. Agr. Kyushu Imp. Univ. 4 (1935) 345.
Vavaea chalmersii C.DC., Bull. Herb. Boiss. II, 3 (1903) 177; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 297, incl. var. *angustifolia* Merr. & L.M. Perry.
Vavaea ardisiodes Elmer, Leafl. Philipp. Bot. 8 (1915) 2767; 9 (1937) 3391; Merr., Philipp. J. Sc., Bot. 13 (1918) 301; Enum. Philipp. Flow. Pl. 2 (1923) 359.
Vavaea surigaoensis Elmer, Leafl. Philipp. Bot. 8 (1915) 2768; Merr., Philipp. J. Sc., Bot. 13 (1918) 301; Enum. Philipp. Flow. Pl. 2 (1923) 360.
[*Vavaea pauciflora* Ridley, Trans. Linn. Soc. II, Bot. 9 (1916) 26, nom. illeg., non Volk.]
Vavaea retusa Merr., Philipp. J. Sc., Bot. 13 (1918) 301; Enum. Philipp. Flow. Pl. 2 (1923) 360.
Vavaea pilosa Merr., Philipp. J. Sc., Bot. 13 (1918) 302; Enum. Philipp. Flow. Pl. 2 (1923) 360.
Vavaea heterophylla Merr., Philipp. J. Sc., Bot. 13 (1918) 303; Enum. Philipp. Flow. Pl. 2 (1923) 360.
Vavaea pachyphylla Merr., Philipp. J. Sc., Bot. 13 (1918) 304; Enum. Philipp. Flow. Pl. 2 (1923) 360.
[*Vavaea sorsogonensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 359, nom. in syn.]
Lamiofrutex papuanus Laut., Nova Guinea 14 (1924) 147.
Vavaea bougainvillensis B.L. Burtt, Kew Bull. (1935) 304.
Vavaea oligantha B.L. Burtt, Kew Bull. (1935) 304.
[*Vavaea luzonensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 3390, nom. in syn.]
Vavaea scaevoloides Guillaumin, J. Linn. Soc., Bot. 51 (1938) 550.
Vavaea kajewskii Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 298.
Vavaea archboldiana Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 298.
Vavaea ledermannii Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 98, 177, t. 25, nom. non rite publ.; Bot. Jahrb. 72 (1942) 159.
Beilschmiedia brassii Allen, J. Arnold Arbor. 23 (1942) 130. — *Vavaea brassii* (Allen) Kosterm., Reinwardtia 5 (1961) 377.
Vavaea brevipedunculata Kurata, Bull. Tokyo Imp. Univ. For. 35 (1947) 198, t. 1.
Vavaea lamii Steenis, Acta Bot. Neerl. 1 (1952) 93.
Vavaea australiana S.T. Blake, Austral. J. Bot. 2 (1954) 122, t. 4.

Treelet or tree to 30 m, usually much less, bole to 30 cm diam.; buttresses usually absent, rarely to 3 m tall, 2 m out. Bark brown, smooth, lenticellate to scaling, scales c. 5–10 by 5 mm; inner bark off white; sapwood off white, darkening on exposure. Leafy *twigs* 2–5(–10) mm diam. *Leaves* (2–)3–22(–27) by (2–)5–9(–13) cm, oblanceolate to obovate, rarely orbicular, in terminal rosettes, subglabrous to densely hispid; base cuneate to attenuate, rarely truncate; apex obtuse, with or without an acute to obtuse acumen, less often ± truncate; veins 6–11(–16) on each side, venation sometimes conspicuously reticulate; petiole (2–)3–22(–45) mm. *Inflorescence* (1.5–)2–13(–15) cm, axillary or occasionally supra-axillary, rarely subtended by a few subulate leaves, sweetly scented (*Gardenia* acc. to Kostermans); axes ± pubescent; bracts 1–4(–40) mm, linear-lanceolate, rarely foliaceous; pseudopedicels 1–5 mm. *Calyx* 1–3.5(–5) mm long, 4–6(–7)-lobed, the lobes deltate, ovate or oblong, with open aestivation, rarely foliaceous and ± imbricate at base. *Petals* (3–)4–6, 4–9.5 mm long, oblong to oblanceolate or rarely spatulate, rather fleshy, imbricate or rarely contorted. *Filaments*

white or pinkish becoming yellow with age united for 1/5 to almost all of length, rarely with an apical pair of small lobes; staminal tube cyathiform or short-tubular, 2–5.5 mm long, 2.5–3 mm diam., hirsute distally without, densely barbate at throat, often purplish; anthers 9–17, 0.3–1.2 mm long, ovoid or subspherical, rarely elongate, glabrous or with a few hairs on connective. *Disk* 0.5–2 mm long, patelliform, cyathiform or shortly tubular, glabrous to pubescent. *Ovary* 2–4-locular; locules with 1 or 2 (3) collateral ovules; stylehead flattened-capitate. *Berry* 0.8–2 cm diam., globose, rarely apiculate, purplish black when ripe; pericarp usually thin and fleshy, rarely thickened and woody. *Seeds* 1–4.

Distribution — Tropical Australia (Northern Territory, Queensland), Caroline Is., Solomon Is., New Hebrides, Fiji, Tonga and *Malesia:* Sumatra (C?), Java (W), Borneo (N and E), Philippines (Palawan, Batanes, Luzon, Catanduanes, Masbate, Samar, Leyte, Panay, Basilan, Mindanao), Celebes (SW), Moluccas (Ceram, Talaud, Tanimbar), New Guinea, New Britain, New Ireland. The Sumatra record is based on a specimen collected by Junghuhn and discussed by Van Steenis in Bull. Bot. Gard. Buitenzorg III, 18 (1950) 457.

Habitat & Ecology — Primary and secondary forests to 1250 m altitude, frequently, as in Java, Borneo, New Guinea and New Ireland, on limestone.

Systematics — The variation of this species is amply discussed by Pennington (1969) who shows that there are four main centres of variation: the Philippines, New Guinea, the Solomon Islands and Fiji, in each of which the variation is similar and principally involves leaf-shape, leaf abaxial surface indumentum, petiole and inflorescence lengths. Locally distinct entities may be recognized by these distinctions but break down elsewhere. The whole appears to represent an ochlospecies similar to that in *Chisocheton lasiocarpus* and *C. patens* (q.v.), though both these are found in more restricted areas. For a different view see A.C. Smith, Fl. Vit. Nov. 3 (1985) 530–536.

Vernacular names — Borneo: chendana, sendana (Bajau); Philippines: bagodan (Mbo), sandana(n) (Sbl., Sul., Tag.); Moluccas: antamata (Talaud); New Guinea: agak (Hattam), arasouwja (Maibrat), binain (Oriomo), kellem, okalemie (Mooi), kobiarap(i) (Japen), mandebay, mandoboi, mandorin (Biak), magahenoui (Wagu), mechem (Waskuk), menako, setakko (Manikiong), nakowie, nimum (Kebar), tavura (Arguni); New Britain: navilavila.

Uses — The wood is considered a substitute for sandalwood in Fiji and the Caroline Islands while, in northern Borneo, it is rubbed over the bodies of the dead. The wood has some uses in house construction too.

Note — According to Pennington (1969: 352), building on the earlier observations of Gray, some flowers are functionally female, having narrow, rather shrunken anthers without good pollen and, indeed, some trees appear to be entirely female, with few-flowered inflorescences, the flowers with fewer (10–12) non-functional anthers. Some trees have flowers with fertile anthers and have young fruits on the same shoot and he concludes that the flowers are probably hermaphrodite. The other species in the genus appear to have hermaphrodite flowers only.

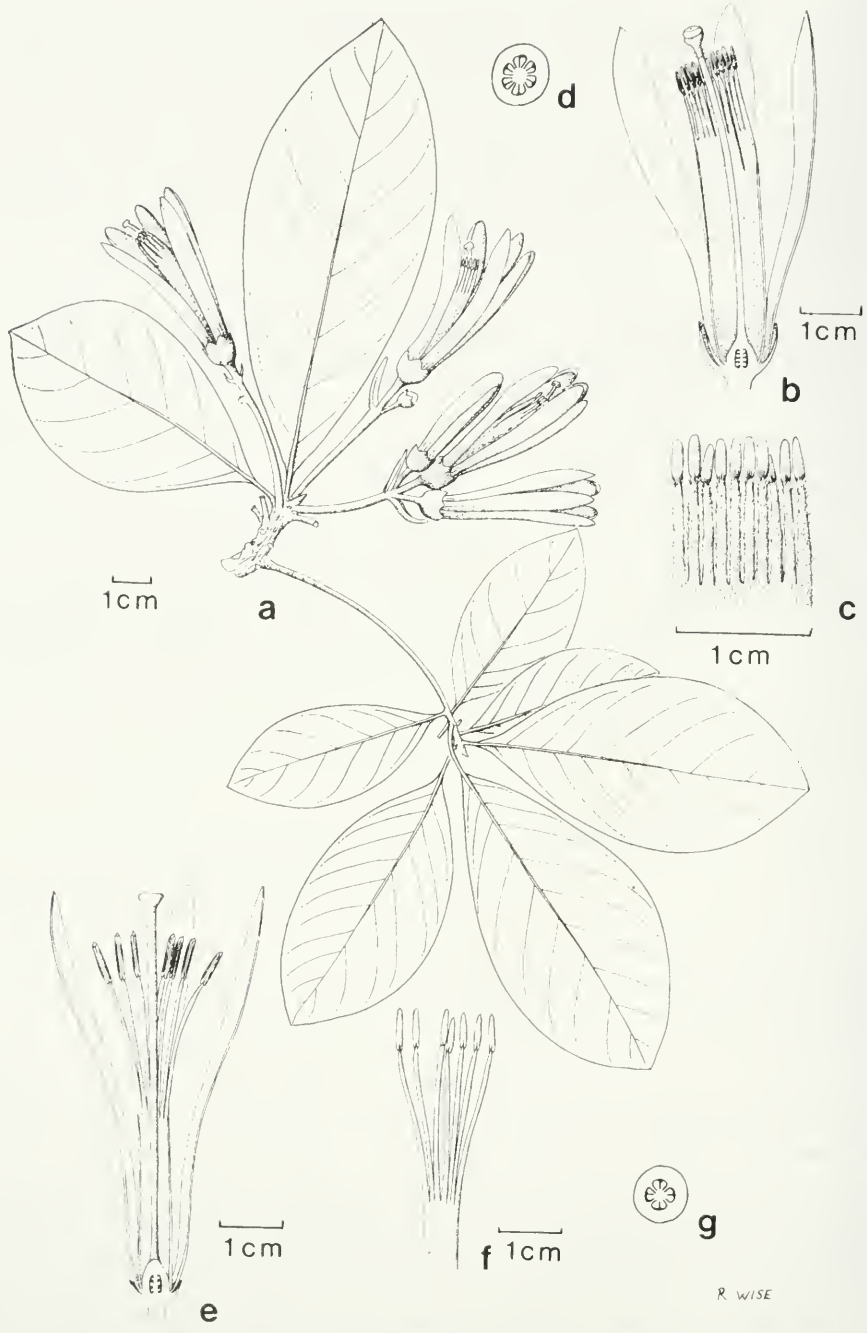

Fig. 4. *Vavaea tubiflora* T.D. Penn. a. Flowering twig; b. half flower; c. outside of staminal tube apex; d. ovary, transverse section. — *V. papuana* F.M. Bailey. e. Half flower; f. outside of staminal tube apex; g. ovary, transverse section (a–d: *Pennington 8050*; e–g: *Brass 25848*). Drawing R. Wise.

Section Grandiflorae

Vavaea sect. *Grandiflorae* T.D. Penn., Blumea 17 (1969) 363.

Petals 3.5–8 cm long. *Staminal tube* 3.5–6.7 cm long, not barbate at throat; anthers 12–23, 2.5–6.5 mm, elongate, pollen grains 115–130 µm long, zonorate. *Ovary* locules 4–10-ovulate.

Distribution — Two species in eastern New Guinea.

2. Vavaea papuana F.M. Bailey

Vavaea papuana F.M. Bailey, Queensl. Agr. J. 3 (1898) 282, t. 53; C.DC., Bull. Herb. Boiss. II, 3 (1903) 177; T.D. Penn., Blumea 17 (1969) 363, f. 2e–g; Blumea 22 (1975) 465, f. 5b.

Treelet or tree to 4 m. *Leaves* 9.5–31 by 4–12 cm, oblanceolate or obovate, glabrous or with a few hairs on midrib abaxially; base cordate or obtuse, rarely acute or cuneate; nerves (7–)9–14 on each side; petiole 2–5(–15) mm. *Flowers* solitary or usually in a few-flowered thyrse, 4.5–20 cm, axillary to supra-axillary, sometimes subtended by a minute bract, fragrant; axes glabrous to weakly pubescent; bracts 2–5(–12) mm, linear-lanceolate, rarely foliaceous; pseudopedicels (5–)8–19 mm. *Calyx* (2.5–)3–6 mm long, persistent in fruit, margin truncate or shallowly 4- (or 5-)lobed, lobes deltate or obtuse, aestivation open. *Petals* 4, 4–8 cm long, ligulate, imbricate, recurved at anthesis, cream. *Filaments* united to about halfway; tube 3.6–6.7 cm, 1–3 mm diam., cylindrical, glabrous to rarely sparsely hairy without, pubescent within or sometimes glabrous in distal half; anthers 2–15(–23), 3–6.5 by 0.5-1 mm, glabrous. *Disk* 0.5–1.5 mm long, 2 mm diam., patelliform or cyathiform, glabrous or hairy. *Ovary* 4-locular, locules with 4–8 ovules in 2 vertical rows; style slender; stylehead capitate. *Berry* 1.2–1.8 cm long, globose to ellipsoid and beaked, often constricted between seeds; pericarp thin, fleshy. *Seeds* 2–5. — **Fig. 4e–g.**

Distribution — *Malesia:* Papua New Guinea.

Habitat — Rain forest to 70 m altitude.

3. Vavaea tubiflora T.D. Penn.

Vavaea tubiflora T.D. Penn., Blumea 17 (1969) 365, f. 2a–d.

Tree to 30 m; bole to 25 cm dbh. Bark smooth, grey-brown with large pale lenticels; inner bark pale brown, camphor- or soap-scented. *Leaves* (5–)10–23.5 by (2–)4.5–11 cm, obovate or elliptic, glabrous or veins with a few hairs; base acute to cuneate; apex acute to obtuse, sometimes acuminate; nerves 9–13 on each side; petiole 0.9–3 cm. *Thyrse* 5–14 cm, axillary to supra-axillary, few-flowered, held above foliage, scentless by day at least; axes ± adpressed pilose; bracts 0.9–2 cm, linear lanceolate or sometimes foliaceous; pseudopedicels 0.5–1.1 cm. *Calyx* 5–9 mm long, circumscissile at base and not persistent in fruit, margin obscurely 5- or 6-lobed, lobes acute or obtuse, aestivation open. *Petals* 5 (6), 3.6–6.5 cm long, ligulate, imbricate, whitish violet. *Filaments* united almost to apex, free in distal 5–9 mm; tube 3.5–5.3 cm long, 4–8 mm

Fig. 5. *Vavaea tubiflora* T.D. Penn. Flowers. Papua New Guinea, Morobe Prov. (*Mabberley 1768*). Photograph D.J. Mabberley, June 1974.

diam., cylindrical, weakly curved, violet, most intensely at apex, pilose on both surfaces, sometimes split down one side; anthers 18–21, 2.5–3 by 0.5–1.5 mm, elongate, glabrous or connective with a few hairs. *Disk* absent or 1–1.5 mm long, 2.5–6 mm diam., patelliform, cyathiform, hirsute. *Ovary* 5- or 6-locular, sometimes hairy within, locules 8–10-ovulate, the ovules superposed, in 2 ranks; style stout, white; stylehead subdiscoid. *Berry* at least 3 cm diam., globose with small beak, or ovoid; pericarp thick, tough. *Seeds* 2. — **Fig. 4a–d, 5.**

Distribution — *Malesia:* Papua New Guinea incl. Rossel Island.

Habitat — Primary and secondary rain forest, to 900 m altitude.

Note — The absence of scent by day suggests that the pollinators may be night-flying moths (Pennington, l.c.: 352).

Tribus Trichilieae

Trichilieae DC., Prodr. 1 (1824) 622; T.D. Penn., Blumea 22 (1975) 466; Mabb. & T.P. Clark, Nat. Monsp., h.s. (1991) 582; T.P. Clark, Stud. Trich.–Walsura Comp. (1991) 291.

Plants dioecious or flowers hermaphrodite. *Leaves* usually pinnate, rarely trifoliolate or unifoliolate. *Indumentum* of simple or stellate hairs. *Staminal tube* usually complete or filaments partially connate, rarely free; anthers nearly always inserted apically on margin of staminal tube or on filaments. *Disk* small, usually annular or patelliform. *Fruit* a capsule, berry or drupe. *Seed* usually arillate or with sarcotesta, usually without endosperm; cotyledons usually collateral.

Eleven or twelve genera, pantropical.

HEYNEA

Heynea Roxb. [Hort. Beng. (1814) 33, nom. nud. ('*Heynia*')] ex Sims in Curt., Bot. Mag. 41 (1815) t. 1738; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 117, t. 31, f. E_1, F_1; T.P. Clark, Stud. Trich.–Walsura Comp. (1991) 285; T.P. Clark & Mabb., Nat. Monsp., h.s. (1991) 582. — *Walsura* Roxb. sect. *Heynea* (Roxb. ex Sims) Harms, Nat. Pflanzenfam. 3, 4 (1896) 303, nom. illeg.

Ailantopsis Gagnep., Not. Syst. 11 (1944) 163.

Picroderma Gagnep., Not. Syst. 11 (1944) 165.

Trichilia auct. non L.: Bentv., Acta Bot. Neerl. 11 (1962) 12, p.p.; T.D. Penn., Blumea 22 (1975) 467, p.p.

Trees. *Twig* pith vesselless. *Indumentum* of simple hairs. *Leaves* imparipinnate; rachis compressed, not swollen at points of attachment of leaflets; abaxial surface of leaflets papillate, glandular. *Inflorescences* corymbose cymes with long peduncles. *Calyx* 4- or 5-lobed, the lobes imbricate. *Petals* 4 or 5, ± imbricate. *Androecium* with cylindrical staminal tube to 1/3 length with 8 or 10 filaments with bifid apices. *Disk* annular. *Ovary* 2- or 3-locular, each locule 2-ovulate; stylehead 2- or 3-lobed. *Fruit* a capsule; pericarp with sclereids. *Seeds* 1 or 2, arillate. 2n = 28.

Distribution — Two species of E and SE Asia: *H. velutina* How & Chen (*Trichilia sinensis* Bentv.) of Indochina and southern China, marked by its hairy 2-seeded capsules, and the closely allied *H. trijuga*, which is a native of Indomalesia.

Note — Recently amalgamated with *Trichilia* L., *Heynea* is distinct in its transversely compressed rachis at leaflet attachment points, its 2-locular ovary and details of its capsule dehiscence, and on isozyme evidence (T.P. Clark & Mabb., l.c.; T.P. Clark, l.c.).

Heynea trijuga Sims

Heynea trijuga [Roxb., Hort. Beng. (1814) 33, nom. nud. ('*Heynia*') ex] Sims in Curtis, Bot. Mag. 41 (1815) t. 1738; Roxb., Pl. Coast Corom. 3 (1820) 56, t. 260; DC., Prodr. 1 (1824) 624; Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 235, t. 7, f. 17; G. Don, Gen. Syst. 1 (1831) 685; Roxb., Fl. Ind., ed. Carey 2 (1832) 390; J. Graham, Cat. Pl. Bombay (1839) 31; Voigt, Hort. Suburb. Calc. (1845) 135; Dalz. & Gibs., Bomb. Fl. (1861) 38; Drury, Handb. Ind. Fl. 1 (1864) 166; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 61; Brandis, For. Fl. (1874) 70; Hiern in Hook. f., Fl. Brit. India 1 (1875) 565; C.DC. in DC., Monogr. Phan. 1 (1878) 713, t. 9, f. 6, incl. var. *bijuga* C.DC., var. *multijuga* C.DC. & var. *pilosula* C.DC.; Talbot, Trees Bomb. (1894) 42; King, J. As. Soc. Beng. 64, ii (1895) 86; Pierre, Fl. For. Cochinch. 5 (1897) t. 355a, incl. var. *microcarpa* Pierre; Cooke, Fl. Bomb. 2 (1902) 214; Brandis, Indian Trees (1906) 134, f. 64; Pellegr. in Fl. Indo-Chine 1 (1911) 791, incl. var. *microcarpa*; Dunn, J. Linn. Soc., Bot. 39 (1911) 455; Crev. & Lem., Cat. Prod. Indoch. 1 (1917) 230, t. 84, incl. var. *microcarpa*; Basu, Ind. Med. Pl. (1918) t. 226; Fyson, Fl. Nilgiri 3 (1920) 303; Ridley, Fl. Malay Penins. 1 (1922) 413; Osmaston, For. Fl. Kumaon (1927) 87; Merr., Lingn. Sc. J. 5 (1927) 104, incl. var. *microcarpa*; Craib, Fl. Siam. Enum. 1 (1931) 264, incl. f. *pubescens* (Kurz) Craib; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 117, incl. var. *microcarpa*; Corner, Wayside Trees 1 (1940) 462, incl. var. *multijuga*; Harms, Notizbl. Bot. Gart. Berl. 15 (1941) 472; Gagnep., Not. Syst. 13 (1947) 63, incl. var. *velutina* Gagnep.; Chitt., Dict. Gard. 2 (1951) 993; T.P. Clark & Mabb., Nat. Monsp., h.s. (1991) 583; Hô, Ill. Fl. Vietnam 2, 1 (1992) 507, incl. var. *microcarpa*. — *Walsura trijuga* (Sims) Kurz, J. As. Soc. Beng. 44, ii (1875) 148, incl. var. '*genuina*' & var. *pubescens* (Kurz) Kurz; For. Fl. Burma 1 (1877) 225; Theob. in Mason, Burma, ed. 3, 2 (1883) 585, incl. var. '*genuina*' & var. *pu-*

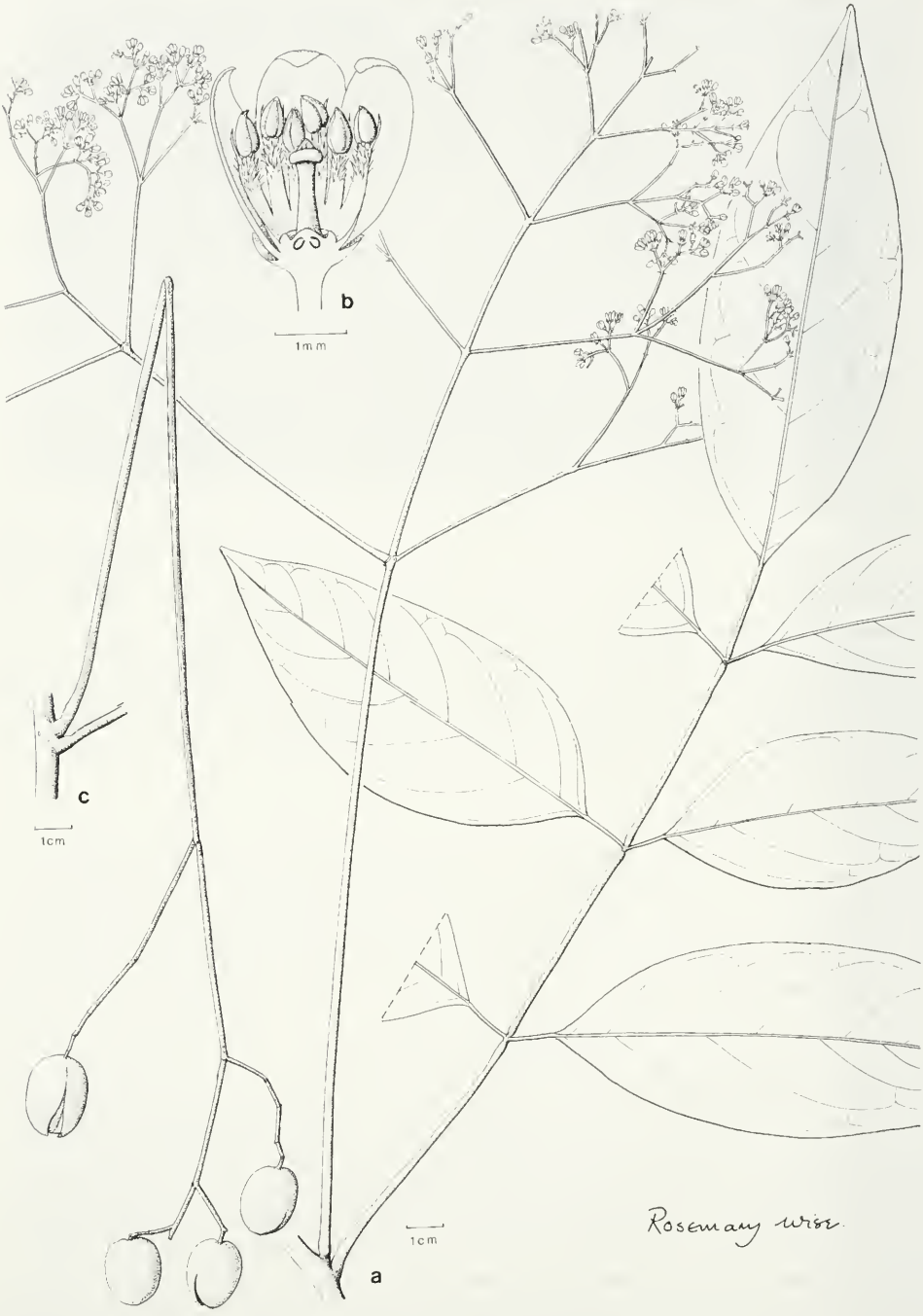

Fig. 6. *Heynea trijuga* Roxb. ex Sims. a. Habit; b. half flower; c. infructescence (a, b: *Mabberley 1677*; c: *Kostermans 5126*). Drawing R. Wise.

bescens; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 303; Adelb., Blumea 6 (1948) 322; Kitam. in Kihara, Fauna & Fl. Nepal (1955) 170.

Heynea quinquejuga Roxb., [Hort. Beng. (1814) 90 ('*quinquijuga*'), nom. nud.] Fl. Ind., ed. Carey 2 (1832) 391 ('*quinquijuga*'), non Spreng. (1827); A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 235; Voigt, Hort. Suburb. Calc. (1845) 135; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 61. — *Walsura quinquejuga* Kurz, Prel. Rep. Veg. Pegu App. A (1875) xxxiii & B (1875) 37.

Heynea affinis A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 239* ('238'); Linnaea 6, Lit. (1831) 113; Mém. Mus. Hist. Nat. Paris 19 (1832) 235, 275; Wight & Arn., Prodr. 1 (1834) 121; Walp., Rep. 1 (1842) 432; Drury, Handb. Ind. Fl. 1 (1864) 166; Bedd., Fl. Sylv. Madras 1 (1869) 134, t. 134.

Zanthoxylum ? connaroides Wight & Arn. in Wight, Cat. Ind. Pl. (1833) 34 ('*Zygophyllum*'), nom. nud.; Prodr. 1 (1834) 148 ('*Zanthoxylon*'). — *Heynea connaroides* (Wight & Arn.) Voigt, Hort. Suburb. Calc. (1845) 136; Drury, Handb. 1 (1864) 166. — *Trichilia connaroides* (Wight & Arn.) Bentv., Acta Bot. Neerl. 11 (1962) 13, incl. f. *glabra* Bentv. and var. *microcarpa* (Pierre) Bentv.; Kosterm., Reinwardtia 7 (1969) 438; Corner, Wayside Trees, ed. 3 (1988) 508; Mabb. in Tree Fl. Malaya 4 (1989) 251; Hô, Ill. Fl. Vietnam 2, 1 (1992) 488, incl. f. *glabra* Bentv.; Debnath & Sreek., J. Econ. Tax. Bot. 16 (1992) 219.

Melia integerrima Buch.-Ham., Trans. Linn. Soc. 17 (1835) 231. — *Azadirachta integerrima* M. Roem., Synops. Monogr. 1 (1846) 97, nom. provis.

Heynea sumatrana Miq., Fl. Ind. Bat., Suppl. (1861) 197, 505; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 60; C.DC. in DC., Monogr. Phan. 1 (1878) 714; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 4; Merr., Philipp. J. Sc., Bot. 4 (1909) 273; Backer, Schoolfl. (1911) 216; Merr., Enum. Born. Pl. (1921) 323; Enum. Philipp. Flow. Pl. 2 (1923) 380; Baker f., J. Bot. 62 Suppl. (1924) 20; Elmer, Leafl. Philipp. Bot. 9 (1937) 3382. — *Walsura sumatrana* (Miq.) Harms ex Koord., Exk. Fl. Java 2 (1912) 447; H.J. Lam, Bull. Jard. Bot. Buitenzorg III, 12 (1932) 422.

Heynea fruticosa Teijsm. & Binn., Nat. Tijds. Ned.-Indië 25 (1863) 423; Kurz, J. As. Soc. Beng. 39, ii (1870) 72 ('*frutescens*').

Walsura pubescens Kurz, J. As. Soc. Beng. 41, ii (1872) 297; For. Fl. Burma 1 (1877) 225.

Walsura perrottetii C.DC., Ann. Cons. Jard. Bot. Genev. 10 (1907) 152.

Scutinanthe engleri Elmer, Leafl. Philipp. Bot. 1 (1908) 298.

Walsura tenuifolia Ridley, J. Roy. As. Soc. Str. Br. 75 (1917) 17; Fl. Malay Penins. 1 (1922) 413.

Walsura intermedia Craib, Bull. Misc. Info. Kew (1926) 345.

Walsura pallida Craib, Bull. Misc. Info. Kew (1926) 345.

Ailantopsis poilanei Gagnep., Not. Syst. 11 (1944) 163.

Picroderma laotica Gagnep., Not. Syst. 11 (1944) 166.

Walsura punctata Suess., Mitt. Bot. Staatssamml. Münch. 1 (1950) 58, excl. var. *papillosa* Suess. & Heine.

Small tree to 15 m with airy crown and bole to 20 cm diam. but usually much smaller. Bark dark brown, lenticellate to grey and weakly cracking into irregular rectangles; inner bark whitish. Young *twigs* very dark brown to blackish, lenticellate, leafy ones c. 4–7 mm diam. All foliage and inflorescences in current flush. *Leaves* to 50 cm long, (1–)3–5(–6)-jugate; petiole 5–15 cm, terete; leaflets 4.5–20 by 2–7.5 cm, ovate-oblong, articulated at petiolule apices, adaxial surface glabrous, shining, abaxial glabrous to hairy, glaucous; base asymmetric, rounded to acute; apex acuminate; veins 5–8 on each side, looping together but not reaching margin. *Inflorescences* foamy subcorymbose cymes to 50 cm across, axillary, peduncle over half as long, with 3–7 pairs of decussate branches, each with 1–3(–4) orders of branchlets; bracts small, caducous. *Flowers* scented; pedicels c. 1.5–2 mm, each with 2 small persistent bracteoles. *Calyx* c. 1 mm high, pale pink, lobes broadly triangular, apices rounded to acuminate, often hairy without, margin sometimes ciliate. *Petals* oblong, c. 0.7–1 mm wide, acute, often hairy without, white to pink or cream, margin sometimes ciliate. *Filaments* 8 or 10 (14)

Fig. 7. *Heynea trijuga* Sims. Flowering shoot. Sabah, Sepilok Forest Reserve (*Mabberley 1677*). Photograph D.J. Mabberley, June 1974.

alternately long and short, adaxially strigose, sometimes puberulous abaxially, pink; anthers c. 1 mm, ovate, apiculate, ± glabrous, bright yellow, inserted between 2 linear acute glabrous teeth. *Disk* fleshy. *Ovary* glabrous. *Capsule* c. 1–2 cm diam., globose, pink. *Seed* 1, ovoid, almost covered in a white aril, testa dark brown, dangling from long funicle (Ashton). — **Fig. 6, 7.**

Distribution — S India (but not Sri Lanka), Sikkim to Nicobars and southern China; *Malesia:* Malay Peninsula, Sumatra, Borneo, Philippines.

Habitat — Rain forest, especially at the edge and in regenerating clearings, and along roadsides, 0–1250 m altitude.

Vernacular name — Borneo: buah pasat (Iban).

Uses — Long cultivated in Java, this is an extremely handsome tree suitable for town gardens (cf. Corner, 1940, 1988); it is cultivated under glass in Europe. Its leaves and bark are bitter and of medicinal value; the seeds are allegedly poisonous to some birds.

WALSURA

(T.P. Clark)

Walsura Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 386; C.DC. in DC., Monogr. Phan. 1 (1878) 633; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 302; ed. 2, 19b1 (1940) 118; T.D. Penn., Blumea 22 (1975) 472; T.P. Clark, Blumea 38 (1994) 257.

[*Monocyclis* Wall., Report E. I. Co. Bot. Gard. (1840) 26, nom. nud.; ex Voigt, Hort. Suburb. Calc. (1845) 135, nom. nud.]

Surwala M. Roem., Synops. Monogr. 1 (1846) 108.

Napeodendron Ridley, J. Roy. As. Soc. Str. Br. 82 (1920) 179.

Trees, unbranched low down or (if tree less than 4 m tall) densely twiggy at breast height, sympodial, leptocaul to pachycaul, buttressed or not. *Twig* pith with vessel elements (cf. *Heynea*). *Indumentum* of simple and/or 2-armed trichomes. *Leaves* usually all along leafy twigs, unifoliolate or imparipinnate with opposite leaflets, 1–4-jugate, to 80 cm long; rachis swollen slightly at the node(s); petiolule usually swollen slightly immediately beneath base of lamina and sometimes slightly geniculate; lamina apex acuminate to obtuse to retuse and base symmetric or slightly asymmetric, abaxial surface glaucous (in vivo) and glabrous to velutinous and sometimes with small glandular bodies (black dots) on either side of and within 2 mm of the midrib. *Inflorescences* axillary (cauliflory unknown), 0.8–30 cm long, each a thyrse with a very dense to open paniculate head. Indumentum of simple and/or 2-armed trichomes. *Flowers* hermaphrodite or unisexual, just prior to opening ± cylindrical and up to 6 mm long, at maximum opening up to 9 mm diam., short pedicel widening almost imperceptibly into calyx. *Calyx* much shorter than the petals, shallowly to deeply 5-lobed, each lobe triangular with entire margins and acute apex. *Petals* 5, free, valvate to imbricate, oblong to narrowly elliptic, apex acute to obtuse and sometimes hooded after opening. *Androecium* of 10 discrete filaments each narrowly triangular or a tube surmounted by 10 ligulate to narrowly triangular filaments, each filament with a truncate or short-bifid apex; anthers 10, deltoid, very short-beaked or not at all. *Disk* annular, glabrous or pubescent. *Ovary* very densely hairy with short erect trichomes or glabrous, 2-locular, each locule with 2 collateral ovules. Style cylindrical to inversely conical. Stigma capitate to short-cylindrical, sometimes with two short lobes at apex. *Fruit* a 1–2(–4?)-seeded berry or 1- or 2-seeded weakly dehiscent septifragal capsule, pericarp leathery with thin layer of sclerenchyma on inside, thin septum separating locules. *Seed* ± ellipsoidal, lacking endosperm, surrounded by transparent sweet fleshy aril. Germination cryptocotylar. 2n = 28.

Distribution — 16 species (including 3 insufficiently known ones) from Assam, the Andaman Islands and tropical China, southeastwards to the Philippines and extreme western Irian Jaya. *Walsura* does not occur naturally in Java or Sumatra.

Habitat — The species in the Malesian region are usually sub-canopy trees of wet evergreen forest.

Ecology — *Walsura dehiscens* is the only species known to have a dehiscent fruit. It is not yet known how this affects seed dispersal but berries of the other species have a succulent, sweet aril and are readily taken by birds and gibbons. Squirrels will eat the aril of these berries and discard the seed and pericarp.

Uses — Used locally as a source of hard, durable timber. *Walsura robusta* (in combination with other timbers) has been used in paper manufacture. No evidence of the use of the aril (see above) as a human foodstuff can be found.

Notes — 1. All species seem to lack exudate of any sort in slash bark or wood. However, most of the species have glands on the undersurface of the leaf and, since they exude small quantities of sweet colourless liquid, are probably best regarded as extrafloral nectaries.

2. Bark morphology seems to be of some taxonomic value but observations are few, and for some species completely lacking.

3. The glaucous (in vivo) or matt (in sicco) appearance of the abaxial surface of the leaf is due to a papillate epidermis, a feature only found in *Walsura*, *Heynea* (2 spp. in Indomalesia) and *Ekebergia* (4 spp. in Africa) in the *Trichilieae*.

4. Aestivation may vary considerably within a single specimen (from valvate to imbricate) and although much used in the past as a character in this genus, is considered to be of little taxonomic value. A far better character is the proportion of the total androecium length (excluding anthers) which is a tube.

KEY TO THE SPECIES

(excluding one insufficiently known species)

1a. Leaf undivided ..... **5. W. monophylla**
b. Leaf divided 2
2a. Leafy twigs 8–15 mm diam.; leaves 4- (or 5-)jugate (Borneo) ..... **3. W. pachycaulon**
b. Leafy twigs 2.5–8 mm diam.; leaves 1–3-jugate 3
3a. Leaflet abaxial surface white-dotted (matt/glaucous in islets); androecium of discrete filaments ..... **1. W. robusta**
b. Leaflet abaxial surface not white-dotted (matt/glaucous uniformly); androecium tubular for part of its length 4
4a. Leaf 3-jugate only; leaflet apex acuminate for (2–)2.5–5 cm (Sarawak) ..... **4. W. sarawakensis**
b. Leaf 2- (or 3-)jugate; leaflet apex acute or acuminate for < 1.5 cm 5
5a. Fruit terete and indehiscent ..... **2. W. pinnata**
b. Fruit 4-winged to rhomboidal (in transverse section) and weakly dehiscent (Borneo) ..... **6. W. dehiscens**

Section Surwala

Walsura sect. *Surwala* (M. Roem.) Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 336. — *Surwala* M. Roem., Synops. Monogr. 1 (1846) 108.

Androecium of discrete filaments; disk pubescent; inner surface of pericarp densely pubescent.

1. Walsura robusta Roxb.

Walsura robusta Roxb. [Hort.Beng. 32 (1814), nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 386; Wight & Arn., Prod. Fl. Pen. Ind. Or. 1 (1834) 120, excl. specim.; M. Roem., Synops. Monogr. 1 (1846) 108, excl. specim.; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 60; Hiern in Hook. f., Fl. Brit. India 1 (1875) 565; Kurz, J. As. Soc. Beng. 44, ii (1875) 148; Prelim. Rep. Veg. Pegu App. B (1875) 37; For. Fl. Brit. Burma 1 (1877) 223; C.DC. in DC., Monogr. Phan. 1 (1878) 638; King, J. As. Soc. Beng. 64, ii (1895) 85; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 302; ed. 2, 19b1 (1940) 119; Prain, Bengal Pl. 1 (1903) 317; ed. 2, 1 (1963) 221; Brandis, Indian Trees (1906) 137; Lecomte in Fl. Indo-Chine (1911) 785; Lace, List Trees etc. Burma (1912) 26; Schmidt, Fl. Koh Chang (1916) 405; Craib, Fl. Siam. Enum. (1926) 262; Kanjilal et al., Fl. Assam 1 (1937) 241; Vidal, Nom. Vernac. Pl. Use Laos (1959) 607; Nir, Burmese Flow. Pl. 1 (1963) 173; Chun et al., Fl. Hainanica 3 (1974) 71; Suvatti in Fl. Thail. 2 (1978) 727; Balakrishnan, Fl. Jowai 1 (1981) 122; Deb, Fl. Tripura State 1 (1981) 453; Haridasan & Rao, For. Fl. Meghalaya 1 (1985) 214; Chen Ximu et al., J. Bot. Res. 4 (1986) 177; Hô, Ill. Fl. Vietnam 2, 1 (1992) 508; T.P. Clark, Blumea 38 (1994) 259, f. 1, 2. — [*Monocyclis robusta* Wall., Rep. E. I. Co. Bot. Gard. (1840) 26, ex Voigt, Hort. Suburb. Calcutt. (1845) 135, nom. nud.] — *Surwala robusta* (Roxb.) M. Roem., Synops. Monogr. 1 (1846) 108.

[*Scytalia glabra* Buch.-Ham. ex Wall., Cat. (1847) 8048E, nom. nud.]

Scutinanthe boerlagii Hochr., Pl. Bogor. 64 (1904); H.J. Lam, Bull. Jard. Bot. Buitenzorg III, 12 (1932) 422; see Leenhouts, Fl. Males. I, 5 (1956) 249.

Trees to 25(–31) m tall, dbh to 1.5 m; outer bark grey-brown, inner bark pink-red. Leafy *twigs* 2–3.5 mm thick, glabrous to puberulous with simple trichomes, bark dark brown to black and very densely lenticellate. *Leaves* 14–18(–28) cm long, 2-jugate; petiole 2–4(–6) cm long, 0.5–1.8 mm thick, semi-terete and flattened adaxially for entire length, glabrous to puberulous with simple trichomes, usually sparsely to densely lenticellate; petiolule ± terete (to slightly flattened adaxially), (of distal pair leaflet:) 0.4–1(–1.7) cm long and 0.5–1 mm thick. Lamina of distal pair *leaflet* 6.4–12.5(–15.5) by 2.8–4(–6.5) cm, of terminal leaflet 6.5–10.5(–16.5) by 3–4(–7) cm, all leaflets (slightly obovate-)elliptic to ovate (basal leaflets usually slightly smaller and tending more to ovate), base acute to short-attenuate, apex acuminate, sub-coriaceous; adaxial surface with no veins prominent, abaxial surface with only midrib and costae prominent and glaucous (in vivo) only in islands between the smallest veins giving surface a whitish-dotted appearance, abaxial surface glabrous to extremely sparsely pubescent with simple trichomes (usually on the sides of the midrib); 5–7(–8) (distal pair leaflet) and 6–8 (terminal leaflet) costae on either side of the midrib; glands present or absent and occasionally conspicuous. *Inflorescences* clustered around shoot apex in the axils of caducous undeveloped leaves or below in the axils of caducous undeveloped or (far less commonly) fully expanded leaves, 5–10(–18) cm long at anthesis, each an open thyrse, branched up to third order (excluding pedicels), first order branches up to (1.5–)3–5 cm long, primary rachis glabrous to densely puberulous with simple trichomes and usually dark brown to black and densely lenticellate. *Flowers* unisexual (and hermaphrodite?), scented, just prior to opening ± cylindrical to inversely conical, 2.7–4 by 2.1–3 mm, at maximum opening 2.5–4.3 mm diam. with no size differences between the sexes. *Calyx* 0.9–1.3 mm long, lobes 0.7–0.9 mm long. *Petals* 2.5–3.4 by 0.9–1 mm, valvate (to slightly imbricate), apex acute with upper c. 1/4 of petal incurved at c. 90° prior to maximum opening, puberulous inside and out. *Androecium* of discrete

filaments, each filament triangular and 1.2–1.3 mm long and 0.6–0.7 mm wide at the base with acute apex, glabrous to sparsely puberulous inside and out. Anthers 0.46–0.50 mm long with a blunt end and no beak, sessile on filament apex, glabrous, the only difference between the sexes being that the female produces solely deformed (i.e. infertile) pollen. *Disk* 0.2–0.4 mm high, minutely puberulous. *Style* in male flower 0.70–0.75 mm long, 0.27–0.33 mm diam., in female flower 1.1–1.2 mm long, 0.4–0.7 mm diam., cylindrical to narrowly conical, glabrous except for ovary-type trichomes near the base. Stigma capitate to short conical, 0.6–0.7 mm diam. at base 0.2–0.5 mm high, with shallow depression at centre (in male) or slightly 2-lobed (in female), below (in male) or above (in female) the level of the anthers at anthesis. *Fruit* a 1- or 2-seeded berry, globose, 1.1–1.9 cm diam., olive-green in vivo and brown in sicco, puberulous, pericarp thin but coriaceous with very thin fibrous endocarp the inside of which (facing the seed) is densely pubescent with simple trichomes. *Seeds* ± globose or (in 2-seeded fruit) hemiglobose and 0.7–1.3 cm long, completely to almost completely enveloped in an aril in vivo, cream-coloured and sweet to taste.

Distribution — Bangladesh, Burma, Andaman Islands, Thailand, Laos, Vietnam; *Malesia:* Peninsular Malaysia.

Notes — 1. Roxburgh provides a description but no Latin name for what he calls 'wallurse' in Med. Facts Obs. 6 (1795) 154.

2. The only precisely localizable collection of this species in Malesia is from Pahang, Taman Negara, Pahang Kuala. Seed harvested with this collection has given rise to a tree, c. 9 m tall in 1987 at FRIM (Kepong).

Section Walsura

Walsura sect. *Walsura*; Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 336; Hiern in Hook. f., Fl. Brit. India 1 (1875) 543 ('*Euwalsura*').

2. Walsura pinnata Hassk.

Walsura pinnata Hassk., Retzia 1 (1855) 147; Miq., Fl. Ind. Bat. 1, 2 (1859) 542; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 60; C.DC. in DC., Monogr. Phan. 1 (1878) 639; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 186; Valeton, Ic. Bogor. 2 (1904) t. 181; Koord., Exk. Fl. Java 2 (1912) 447; Backer & Bakh. f., Fl. Java 2 (1965) 129; Mabb. in Tree Fl. Malaya 4 (1989) 254, t. 9B; T.P. Clark, Blumea 38 (1994) 276, f. 11, 12.

Walsura hypoleuca Kurz, J. As. Soc. Beng. 42, ii (1872) 296; Hiern in Hook. f., Fl. Brit. India 1 (1875) 564; Kurz, Veg. Pegu (1875) 37; For. Fl. Brit. Burma 1 (1877) 224.

Walsura neurodes Hiern in Hook. f., Fl. Brit. India 1 (1875) 564; C.DC. in DC., Monogr. Phan. 1 (1878) 636; King, J. As. Soc. Beng. 64, ii (1895) 84; Ridley, Fl. Malay Penins. 1 (1922) 412; Wyatt-Smith & Kochummen, Mal. For. Rec. 17 (1979).

Heynea cochinchinensis Baillon, Adansonia 11 (1879) 265. — *Walsura cochinchinensis* (Baillon) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 302; ed. 2, 19b1 (1940) 119; Pierre, Fl. For. Cochinch. (1897) 21, t. 354; Pellegrin in Lecomte, Not. Syst. (1910) 227; Hô & Duong, Fl. Vietnam (1960) 244; Hô, Ill. Fl. Vietnam 2, 1 (1992) 508.

Walsura elata Pierre, Fl. For. Cochinch. (1897) 21, pl. 355; Hô, Ill. Fl. Vietnam 2, 1 (1992) 508.

Walsura aherniana Perkins, Fragm. Fl. Philipp. (1904) 34; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 379.

Walsura villamilii Merr., Philipp. J. Sc., Bot. 9 (1914) 308; Univ. Calif. Publ. Bot. 15 (1929) 132.
Napeodendron altissimum Ridley, J. Roy. As. Soc. Str. Br. 82 (1920) 179; Fl. Malay Penins. 1 (1922) 505; Symington, Bull. Misc. Info. Kew (1937) 319.
Walsura angulata Craib, Bull. Misc. Info. Kew (1926) 344; Fl. Siam. Enum. 1 (1926) 261; Suvatti in Fl. Thail. 2 (1978) 727.
Walsura glauca C. Fischer, Bull. Misc. Info. Kew (1927) 87.
Walsura grandifolia Ridley, Bull. Misc. Info. Kew (1930) 370.

Trees, up to 18(–37) m, girth to 0.76(–1.22) m, bole to 11(–24) m; outer bark smooth and thin, light grey-brown, often with lenticels, falling in parts to reveal pink-brown inner bark; sapwood very pink to pale brown to pink-yellow, with slight aroma similar to that of the fruits. Leafy *twigs* slender, 2.5–8 mm diam., glabrous with grey-brown usually lenticellate bark. *Leaves* (9, if leaf undivided, to) 14–70 cm long, undivided to 2- (or 3-)jugate; petiole 2.5–11 cm long, 1–4 mm thick, semi-terete and flattened adaxially, glabrous or extremely sparsely pubescent, occasionally lenticellate near the base; petiolules semi-terete and flattened adaxially, those of lateral leaflets 0.4–1.4 cm long and 0.5–1.5 mm thick, geniculate just below base of lamina. Lamina of distal pair *leaflet* 2–11.5 by 5.5–25 cm, the basal leaflets usually conspicuously smaller and the terminal a little larger, all narrowly oblanceolate, elliptic or oblong, with cuneate or cuneate-attenuate base and acute to short (< 1.5 cm) acuminate apex, subcoriaceous, adaxial surface with most of veins slightly prominent (in sicco and in vivo), abaxial surface (other than midrib and costae) glaucous (in vivo) and glabrous or very sparsely pubescent on midrib and costae only with most (in sicco) or only to second order (in vivo) veins prominent, (of distal pair leaflet) 7–12(–20) costae on either side of midrib or with incomplete costae also (see above); glands usually present. *Inflorescences* clustered around shoot apex in axils of caducous, undeveloped leaves and/or rarely solitary in axils of expanded leaves near the shoot apex, (4–)8–35 cm long at anthesis, an open thyrse, branched up to third order (excluding pedicels), first order branches up to 10 cm long, all parts densely puberulous, rachis occasionally lenticellate; pedicel 0.5–2 mm long. *Flowers* hermaphrodite or male only, just prior to opening ± cylindrical, 2–4 mm long, 2–2.8 mm diam., at maximum opening 3.5–5 mm diam. *Calyx* 1.2–1.9 mm long, lobes 0.7–1.7 mm long, densely puberulous on outside only. *Petals* 3–3.8(–4) by 1.5–1.8(–1.9) mm, imbricate, apex sometimes slightly hooded when mature. *Androecium* cylindrical or slightly ampulliform, (1.7–)2–4.3 mm long, (1.5–)2–2.5 mm diam., tubular for (1/4–)1/2(–2/3) of length with alternate filaments slightly shorter or all to same length, outside glabrous or very sparsely pubescent on tubular part and sparsely to densely pubescent on filaments, inside glabrous on tubular part and densely pubescent on filaments, filament apex bifid with teeth c. 0.2 mm long, stalk to anther 0.2–0.3 mm long, originating just below base of teeth; anther 0.6–0.8 mm long, occasionally shortly beaked, glabrous or puberulous. *Disk* 0.2–0.3(–0.4) mm high. *Ovary* densely hairy or very rarely glabrous. Style cylindrical to narrowly conical, 0.6–0.7(–1.1) mm long and 0.3–0.4 mm diam. at base and 0.3–0.6 mm diam. at top, glabrous. Stigma c. 0.4 mm long, 0.7–1 mm diam., capitate, just below the level of the anthers at anthesis. *Fruit* a 1- (or 2-)seeded berry, globose (to ovoid), 1.2–2.4(–2.8) cm long, 1.2–2.4 cm diam., pale green or red in vivo, brown in sicco, sparsely and minutely puberu-

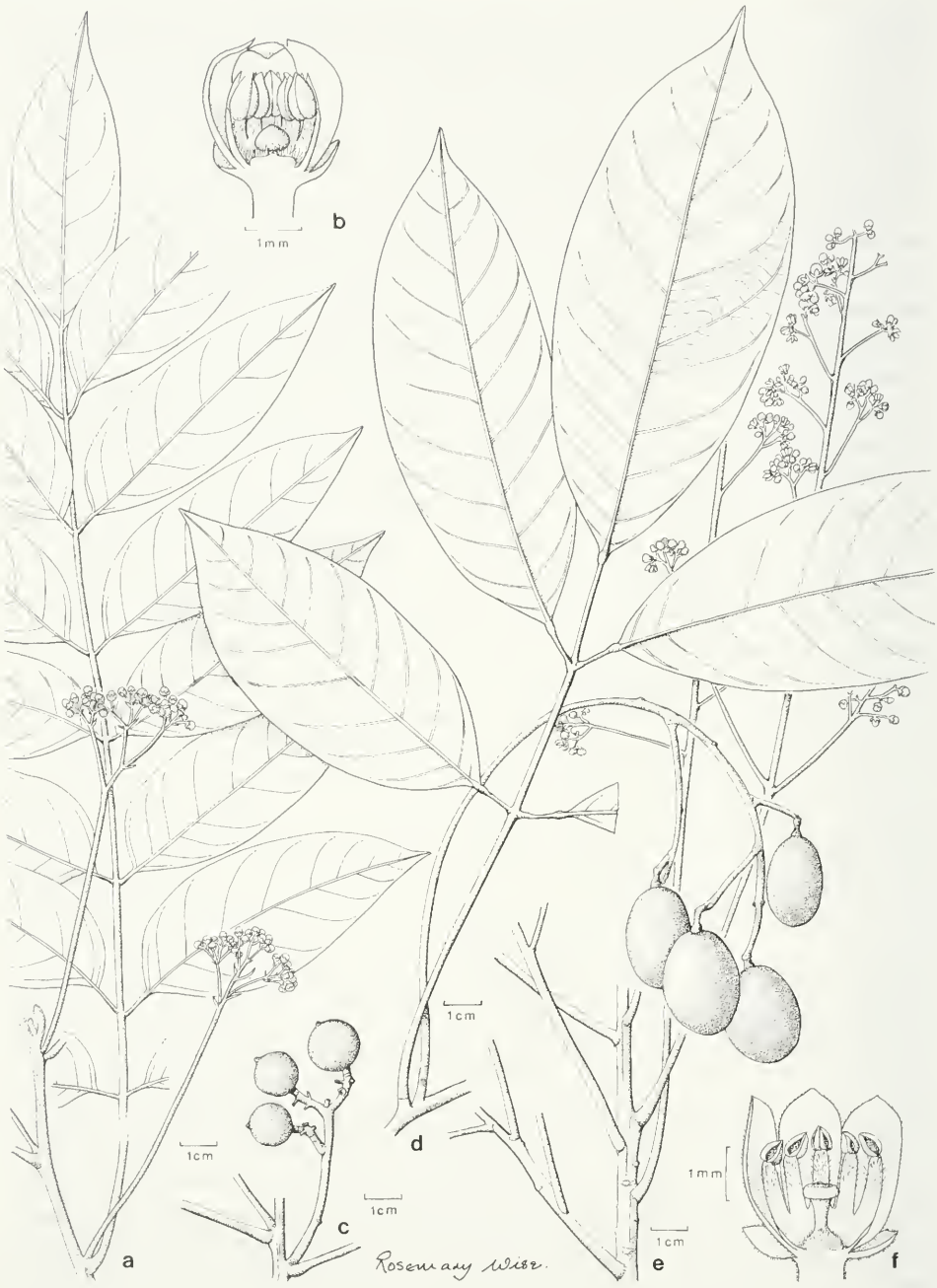

Fig. 8. *Pseudoclausena chrysogyne* (Miq.) T.P. Clark. a. Habit; b. half flower; c. infructescence. — *Walsura pinnata* Hassk. d. Leaf and infructescence; e. inflorescence; f. half flower (d–f: *Griffith 1617/1*). Drawing R. Wise. Reproduced with permission from Tree Flora of Malaya 4.

lous, pericarp thin but coriaceous with very thin fibrous endocarp. *Seeds* ± ellipsoidal, 1.3–2.3 by 0.9–1.3 cm or (in 2-seeded fruit) hemi-ellipsoidal and up to 2.1 cm long, enveloped in a fleshy white or colourless sweet tasting aril which sometimes exudes a clear sticky liquid. — **Fig. 8d–f.**

Distribution — Burma, Thailand, Yunnan, Hainan, Cambodia, Vietnam; *Malesia:* Malay Peninsula, Java (cult.: Bogor), Borneo, Philippines (Palawan to Luzon), Halmahera, extreme western Irian Jaya.

Note — *Walsura pinnata* has the largest range of all the species of *Walsura* (and *Pseudoclausena*) and is highly variable, mainly in leaf and leaflet size but also, to a lesser extent, in leaflet number.

3. **Walsura pachycaulon** T.P. Clark

Walsura pachycaulon Mabb. ex T.P. Clark, Blumea 38 (1994) 280, f. 13, 14.

Trees to 29 m tall, girth to 90 cm; outer bark 0.6–3.8 cm thick and dark grey-brown to blackish; inner bark pink. Leafy *twigs* pachycaul, (0.6–)0.8–1.5 cm diam., sparsely to densely lenticellate, glabrous. *Leaves* 38–60 cm long, 4- (or 5-)jugate; petiole 10–22 cm long and 3–7 mm thick, semi-terete with flat to shallowly canaliculate adaxial surface, sparsely lenticellate and glabrous; petiolule 0.5–2.3 cm long and 0.8–2 mm thick, ± terete. Lamina of distal pair *leaflet* 3.5–6.5 by 13–19.5 cm and basals slightly smaller and terminal slightly larger, all leaflets narrowly oblanceolate or elliptic or oblong, apex acuminate, base cuneate to cuneate-attenuate, subcoriaceous, both surfaces with all veins slightly to conspicuously prominent (in sicco), abaxial surface glabrous to very sparsely pubescent with very short simple trichomes; 9–14 (distal pair leaflets), 10–19 (terminals) and 9–13 (basals) costae on either side of the midrib; glands absent or very sparse and very small. *Inflorescences* clustered around shoot apex in axils of caducous undeveloped leaves, 16–45 cm long at anthesis, each an open thyrse branched to third order (excl. pedicels) with first order branches up to 15 cm long, pedicels 1–2.5 mm long, all parts densely puberulous. *Flowers* hermaphrodite, just prior to opening ± cylindrical, 2.6–3.2 mm long, 2.5–3 mm diam., at maximal opening c. 5.2 mm diam. *Calyx* c. 1.3 mm long, lobes c. 0.5 mm long. *Petals* c. 4.2 by c. 2.2 mm, imbricate. *Androecium* cylindrical to narrowly ampulliform, 2.1–2.4 mm long, 2.2–2.9 mm diam., tubular for c. 1/4 of length, tubular part glabrous on both surfaces, filaments glabrous on outside and pubescent on inside, filament apex bifid with teeth c. 0.1 mm long; anthers c. 0.6 mm long and very short beaked, glabrous except for a short tuft of trichomes from the apex. *Disk* c. 0.7 mm high, glabrous. *Style* 1–1.5 mm long, 0.4–0.5 mm diam. (base) and 0.6–0.7 mm diam. (top), narrowly obconical, glabrous. Stigma c. 0.4 mm high, c. 0.9 mm diam., cylindrical with low-domed top. *Fruit* a 1-seeded globose (to ovoidal) berry, 1.8–4.2 cm diam., brown when mature in vivo, sparsely puberulous, pericarp to 5 mm thick and coriaceous. *Seeds* narrowly ellipsoidal, to 2.8 by 1.6 cm, incompletely (?) surrounded by sweet tasting jelly-like aril.

Distribution — *Malesia:* Borneo (Sabah, Sarawak).

Note — This species is most closely related to *W. pinnata*, but is distinguished from all other members of the genus by its pachycaul leafy shoots and large (i.e. 9 or 11) leaflet number.

4. Walsura sarawakensis T.P. Clark

Walsura sarawakensis T.P. Clark, Blumea 38 (1994) 283, f. 15, 16.

Trees to 6 m tall. Leafy *twigs* 6–8 mm thick, glabrous with light brown sparsely lenticellate bark. *Leaves* 52–80 cm long, 3-jugate; petiole 15–21 cm long, 0.2–0.4 cm thick, semi-terete and flattened adaxially, glabrous to very sparsely puberulous with very short erect trichomes, sparsely lenticellate; petiolule 5–18 mm long, 1–1.5 mm thick, ± terete or slightly flattened adaxially. Lamina of distal pair *leaflet* 24–30 by 5–8 cm, of terminal leaflet 28–41 by 5.8–10 cm, all leaflets lanceolate with short attenuate base and apex acuminate for (2–)2.5–5 cm long, subcoriaceous, all veins prominent on both surfaces, abaxial surface matt on intervenous lamina and over most of smallest veins and very sparsely pubescent with simple trichomes; 14–17 (distal pair leaflet) and 17–18 (terminal leaflet) costae on either side of the midrib; glands conspicuous. *Inflorescences* clustered around shoot apex in axils of (sometimes) caducous undeveloped leaves, 7.5–8 cm long at anthesis, a compact thyrse branched up to second order (excluding pedicels) of which the first order branches can be up to 1.3 cm long, all parts densely puberulous and primary rachis sparsely lenticellate. *Flowers* hermaphrodite, just prior to opening cupiform, c. 2.6 mm long, c. 2.1 mm diam., at maximum opening c. 2.8 mm diam. *Calyx* c. 1.1 mm long, lobes c. 0.8 mm long. *Petals* 3.2–3.5 by 1.7–1.8 mm, imbricate. *Androecium* cylindrical, c. 2 mm long, c. 1.6 mm diam., tubular for 1/2–3/4 of length, alternate filaments very slightly shorter; filaments (inside and out) sparsely pubescent and tubular part glabrous to very sparsely pubescent, filament apex bifid with erect teeth c. 0.3 mm long; anthers c. 0.8 mm long, apex acute to very shortly beaked, very sparsely and minutely puberulous. *Disk* c. 0.3 mm high. *Style* cylindrical, c. 0.5 mm long, c. 0.4 mm diam., glabrous. Stigma capitate, c. 0.7 mm high, c. 1.1 mm diam. at base. *Fruit* a 1–3-seeded berry, ellipsoidal, 2–3 by 1.7–2.5 cm, green to purplish-brown in vivo, brown in sicco, glabrous, pericarp coriaceous. *Seeds* ellipsoidal, 1.8–2.3 by c. 1.4 cm, (in vivo) enveloped in a sticky white aril.

Distribution — *Malesia:* Borneo (Sarawak, known only from five collections from a small area north of Kapit).

5. Walsura monophylla Merr.

Walsura monophylla [Elmer, Leafl. Philipp. Bot. 9 (1937) 3391, descr. angl., ex] Merr., J. Arnold Arbor. 35 (1954) 138, descr. lat.; T.P. Clark, Blumea 38 (1994) 285, f. 17.

Trees to 10 m tall, dbh 10 cm when tree 3 m tall. Leafy *twigs* 2–4.5 mm thick, glabrous and frequently lenticellate, bark rough and dark brown. *Leaves* 8–20(–27) cm long, undivided; petiole plus petiolule 0.8–1.8(–2.8) cm long, 0.8–1.8 mm thick, semi-terete and flattened adaxially, glabrous. *Leaflet* lamina (8–)12–17(–25) by (3.5–)4.5–

5.5(–8.8) cm, lanceolate to elliptic to slightly obovate with very short attenuate base and acute to very short acuminate apex, subcoriaceous to coriaceous, all veins prominent on both surfaces, abaxial surface glaucous (in vivo) on intervenous areas and over the smallest veins and glabrous to very sparsely pubescent with short simple trichomes, (8–) 10–12(–15) costae on either side of the midrib; glands conspicuous. *Inflorescences* clustered around shoot apex in axils of caducous undeveloped leaves or solitary or in pairs in axils of fully expanded leaves below, 6–9 cm long at anthesis, each a ± compact thyrse branched up to second order (excl. pedicels), first order branches up to 3 cm long, all parts sparsely pubescent with short simple trichomes. *Flowers* hermaphrodite, just prior to opening cylindrical to cupiform, 3.5–4.5 mm long, 2–3 mm diam., at maximum opening 4–7.5 mm diam. *Calyx* 1.5–1.7 mm long, lobes 0.8–1.2 mm long. *Petals* 4–4.5 by 1.8–2 mm, slightly imbricate to valvate, apex acute and often slightly hooded. *Androecium* cylindrical to conical, 2.1–3 mm long, 2.1–2.3 mm diam. near base, tubular for 1/3–1/2 of length, alternate filaments slightly shorter; filaments (inside and out) pubescent and tubular part glabrous to very sparsely pubescent, edges of lobes often slightly recurved, lobe apex bifid with erect teeth 0.2–0.4 mm long; anthers 0.8–0.9 mm long, very shortly beaked, glabrous. *Disk* c. 0.4 mm high. *Ovary* very densely pubescent with short simple rigid trichomes. Style 1–1.2 mm long, narrowly and obconical, c. 0.3 mm diam. at base and c. 0.5 mm diam. at top, glabrous. Stigma capitate with flattened or trapezoidal top, not lobed but with a shallow depression at the centre, c. 0.5 mm high, 0.9 mm diam. at base. *Fruit* a 1- or 2-seeded berry, globose, 0.8–1.1 cm diam., pale-green to cream in vivo, olive-green to midbrown in sicco, sparsely puberulous, pericarp very thin and subcoriaceous, surface rugose but almost smooth. *Seeds* ± spherical or ± hemispherical and c. 8 mm long, enveloped in a thin aril?

Distribution — *Malesia:* Philippines (Palawan).

Ecology — This species is largely restricted to ultrabasic soils. It can accumulate nickel to concentrations of about 7000 µg/g, though the fruit scarcely does so [Baker et al., Proc. 1st Int. Conf. Serpentine Biol. (1992) 301]. Several *Dysoxylum* species in New Caledonia are tolerant of ultramafics but only one, *D. minutiflorum* C.DC. is as restricted to them as *Walsura monophylla* is.

Uses — Extracts are proving promising in the treatment of cancer and AIDS in the U.S.A.

Section Ruswala

Walsura sect. *Ruswala* T.P. Clark, Blumea 38 (1994) 287.

Inflorescence < 1.7 cm long at anthesis; fruit dehiscent along 4 sutures.

6. Walsura dehiscens T.P. Clark

Walsura dehiscens T.P. Clark [in T.P. Clark & Mabb., Nat. Monspel., h.s. (1991) 582, fig., nom. nud.]; Blumea 38 (1994) 287, f. 18, 19.

Trees to 9(–13) m tall, girth to 25(–40) cm; outer bark smooth and grey; inner bark pale yellow. Leafy *twigs* 1.5–3.5 mm thick, darkbrown to black-brown and densely lenticellate, glabrous to puberulous with occasional simple trichomes. *Leaves* 25–30 (–35) cm long, 2-jugate; petiole 4.5–9.5 cm long, 1.5–2(–2.5) mm thick, ± terete and slightly flattened adaxially near the very base, sub-densely lenticellate, very sparsely puberulous; petiolule ± terete, (of distal pair leaflet) 0.7–1.4(–2.4) cm long and 0.6–1.2 mm thick. Lamina of distal pair *leaflet* (9–)11–16(–19) by 4–6(–8) cm, of terminal leaflet 11–15(–19) by 5–8 cm, of basal leaflet 8–16 by 4–6(–8) cm, lateral and terminal leaflets elliptic (to obovate), basal leaflets ovate to elliptic, chartaceous to subcoriaceous, adaxial surface with all veins slightly or not at all prominent (in vivo and in sicco), abaxial surface with most veins slightly prominent (in vivo and in sicco) and surface glaucous (in vivo) except for on midrib and costae and (usually) intercostae, abaxial surface very sparsely to densely pubescent (to subtomentose) with ± erect simple trichomes; 7–9 (lateral and terminal leaflets) and 6–8 (basal leaflets) costae on either side of the midrib; glands conspicuous and dense and usually extending along either side of the costae also. *Inflorescences* in axils of undeveloped or fully expanded leaves near the shoot apex or lower down, 1–1.7 cm long at anthesis, each a tightly compact thyrse, branched to first (to second) order, first-order branches up to 4 mm long, peduncle sparsely lenticellate, all parts densely puberulous with simple trichomes. *Flower* hermaphrodite, not scented, just prior to opening cylindrical, 1.5–1.6 mm long, 1.2–1.3 mm diam. *Calyx* 1–1.4 mm long, lobes c. 0.6 mm long. *Petals* 2.2–2.5 by 1–1.8 mm, glabrous on inside. *Androecium* cylindrical to slightly cask-shaped, c. 1.5 mm long, tubular for c. 1/5 of length; filament edges only pubescent, filament apex bifid with teeth c. 0.2 mm long; anthers 0.4–0.5 mm long and very short beaked. *Disk* c. 0.4 mm high. *Style* narrowly obconical, c. 0.5 mm long, c. 0.3 mm diam. at base, c. 0.5 mm diam. just below stigma. Stigma capitate with two lobes on top, c. 0.4 mm long (excl. lobes), c. 0.9 mm diam. at base, lobes c. 0.2 mm high. *Fruit* a 1- (or 2-) seeded capsule, longitudinally 4-winged (immature) to rhomboidal (in transverse section) to almost globose, 1.7–2.5 by 0.6–0.9 cm, green or glaucous in vivo, brown in sicco, puberulous with simple trichomes, pericarp 0.7–1 mm thick generally but up to 1.3 mm thick at the four edges, fibrous endocarp 0.13–0.18 mm thick, septum c. 0.18 mm thick between the two locules connected to pericarp at two opposite suture lines, capsule weakly septicidally dehiscent into 2 (or 4?) valves commencing at the distal end, the septum spliting into two membranes at dehiscence.

Distribution — *Malesia:* Borneo (Sarawak, Sabah, E Kalimantan).

INCOMPLETELY KNOWN SPECIES

7. Walsura spec. A

Tree to 35 m tall, dbh to 0.75 m, buttressed to 1.2 m; bark smooth to flaky, reddish. Leafy *twigs* 2.5–4 mm diam., glabrous, bark light-brown to whitish, lenticellate. *Leaves* 13–24 cm long, 2-jugate. Petiole 2.5–5 cm long, 1.5–2 mm thick, ± terete and

slightly flattened adaxially near the base, densely puberulous with prostrate simple and 2-armed trichomes; petiolules ± terete, those of distal lateral leaflets 0.7–1.2 cm long, 0.7–1 mm thick; lamina (of distal lateral *leaflet*) 8–12 by 3.5–5 cm, (of terminal leaflet) 8–14 by 4–5.5 cm, (of basal leaflet) 7.5–11.5 by 3.5–4 cm, all leaflets elliptic with acute base and very short acuminate apex, subcoriaceous, adaxial surface with no veins prominent, abaxial surface with midrib and costae only prominent and very sparsely pubescent with prostrate simple and 2-armed trichomes; 7–9 (distal lateral), 9–10 (terminal) and 7–8 (basal) costae on either side of the midrib; glands present. *Flowers* unknown. *Fruit* a 1–2-seeded berry, (globose to) ellipsoid, 2.2–2.6 cm long, 1.5–1.8 cm diam., olive-green in vivo, brown in sicco, puberulous with prostrate simple and 2-armed trichomes, pericarp coriaceous with a very thin fibrous endocarp. *Seeds* 1–1.5 cm long, completely enveloped in a fleshy sweet-tasting aril.

Distribution — *Malesia:* Borneo (Sarawak).

Note — This species superficially resembles *W. pinnata*, and in fruit anatomy (except for the 2-armed trichomes) is very similar, but the degree of vein prominence on the undersurface of the leaflet (especially after drying) is very different.

PSEUDOCLAUSENA

(T.P. Clark)

Pseudoclausena T.P. Clark, Blumea 38 (1994) 291.
[*Melospermum* Scort. ex King, J. As. Soc. Beng. 64, ii (1895) 83, nom. in syn.]
Walsura sect. *Neowalsura* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 119.

Leaf abaxial surface epidermis non papillate. *Flower* lacking a disk. *Ovary* 4- or 5-locular. *Fruit* with short beak, slightly asymmetric and completely lacking sclerenchyma.

Distribution — A genus of one highly variable species.

Pseudoclausena chrysogyne (Miq.) T.P. Clark

Pseudoclausena chrysogyne (Miq.) T.P. Clark, Blumea 38 (1994) 291, f. 20, 21. — *Clausena chrysogyne* Miq., Fl. Ind. Bat., Suppl. (1861) 502. — *Walsura chrysogyne* (Miq.) Bakh. f., Blumea 16 (1968) 359; T.D. Penn., Blumea 22 (1975) 474, f. 7a; Mabb. in Tree Flora Malaya 4 (1989) 254, f. 9A.

Cipadessa borneensis Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 6; see Steenis & Bakh. f., Bot. Jahrb. 86 (1967) 399.

Walsura multijuga King, J. As. Soc. Beng. 64, ii (1895) 83; Valeton, Ic. Bog. 2 (1904) t. 135; Ridley, Fl. Malay Penins. 1 (1922) 412; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 2252.

[*Melospermum rubro-stamineum* Scort. ex King, J. As. Soc. Beng. 64, ii (1895) 83, nom. in syn.]

[*Walsura quadrilocularis* Valeton, Ic. Bog. 2 (1906) 156, nom. nud.; Dakkus, Bull. Jard. Bot. Buitenzorg, Suppl. (1930) 295; ibid. ed. 2, 237; ibid. ed. 3, 244; Bakh. f., Blumea 16 (1968) 359 ('*W. quadrangularis*'), nom. in syn.]

Walsura brachybotrys Merr., Philipp. J. Sc., Bot. 8 (1913) 378.

Walsura celebica C.DC., Meded. Rijks Herb. Leiden 22 (1914) 10.

Walsura glabra Merr., Philipp. J. Sc., Bot. 13 (1918) 76.

Walsura borneensis Merr., Univ. Calif. Publ. Bot. 15 (1929) 213; Bakh. f., Blumea 16 (1968) 359.

Walsura hosei Ridley, Bull. Misc. Info. Kew (1930) 371.

[*Walsura palawanensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 3393, nom. nud., descr. angl.]

Trees to 25 m tall, bole to 15 m tall, dbh to 60 cm; outer bark smooth and c. 2 mm thick, unfissured and pale-brown to greyish-brown; inner bark 3–4 mm thick and red-brown; sapwood whitish with red or pink tinge. Leafy *twigs* 1.1–3.5 mm thick, glabrous or puberulous or velvety, trichomes simple, bark midbrown to very light brown or greyish and sometimes sparsely lenticellate. *Leaves* 18–42 cm long, (3–)5–9(–15)-foliolate, brown (to olive green) when dried. Petiole 2.5–8.5 cm long, 0.8–2.1 mm thick, terete or semi-terete slightly flattened adaxially, glabrous or puberulous or velvety, trichomes simple; petiolules ± terete, (of distal lateral leaflet) 1.5–10 mm long, 0.4–0.9 mm thick, glabrous or puberulous or velvety. Lamina (of distal lateral leaflet) (5.3–)7.2–14(–18.5) by 2.3–5(–6.5) cm, (of terminal leaflet) (6.4–)7.2–16.5(–19.5) by 2.4–5(–6.8) cm, (of basal leaflet) 4–12.5 by 1.9–5.5 cm, lateral leaflets on any one leaf of similar areas and basal leaflets usually 1/4–1/2 of this area, ovate to elliptic (to lanceolate) the basal leaflets tending towards a smaller length/width ratio, base attenuate and slightly asymmetric, apex shortly acuminate, subcoriaceous, adaxial surface with no veins or only midrib prominent (in sicco), abaxial surface with only midrib and costae prominent (in sicco) and not glaucous (i.e. epidermis non-papillate) and glabrous to tomentose with simple decumbent to erect trichomes; 6–9(–15) (distal pair leaflet) or 7–10(–15) (terminal leaflet) or 6–9(–14) (basal leaflet) costae on either side of the midrib; glands absent. *Inflorescences* clustered around shoot apex or below in axils of fully expanded or expanding leaves, 1–6(–10) cm long at anthesis, each a very compact to open thyrse, branched up to second (to third) order (excl. pedicels) of which the first order branches are up to 7.5 cm long, primary rachis and all branches lacking lenticels and glabrous to tomentose with simple trichomes. *Flowers* hermaphrodite (with little pollen) or (on different plant) male only (with much pollen), just prior to opening cylindrical to cask-shaped, 3–3.6 mm long, 1.4–2.6 mm diam., at maximum opening 2.9–6 mm diam. *Calyx* 1.5–1.8 mm long, deeply 5-lobed, each lobe 0.8–1.2 mm long with a blunt apex. *Petals* 5, free and imbricate, 2.8–4.8 by 1.5–1.8 mm, narrow-elliptic to oblong, apex acute, pale green. *Androecium* ± cylindrical, 1.5–3.3 mm long, 0.9–1.8 mm diam., tubular for 1/4–1/2 of length, each filament linear or slightly narrowed towards the apex, filament apex bifid with erect to spreading teeth 0.4–0.5 mm long; anthers 0.4–0.5 mm long, glabrous or with a short tuft of trichomes from the apex, pink. *Disk* absent. *Ovary* very densely pubescent with short stiff trichomes, appearing golden or extremely rarely glabrous, 4–5-locular, each locule with one ovule. Style ± cylindrical, 0.4–0.6 mm long, 0.2–0.3 mm diam., glabrous to sparsely pubescent in the lower half. Stigma ± capitate and shortly two-lobed on top, excluding lobes 0.3–0.5 mm high, 0.5–0.6 mm diam. at base, below the level of the anthers at maturity. *Fruit* a 1- or 2-seeded berry, ± globose, 1.3–1.8 cm diam., more or less rusty tomentose, with a short beak, 3–5 mm long, positioned asymmetrically on the fruit, pericarp coriaceous but lacking sclerenchyma, weakly laticiferous, parenchyma with high levels of tannins only. *Seeds* 0.8–1.3 cm long and ± ellipsoidal, dark brown and shining but lacking an aril. — **Fig. 8a–c.**

Distribution — Indochina and *Malesia:* Malay Peninsula (but not Singapore), Sumatra, Borneo, Philippines, Celebes, Moluccas, W New Guinea.

Habitat — Sub-canopy trees of wet evergreen forest.

Ecology — The pericarp of the berries (unlike that of the closely related *Walsura* species) lacks sclerenchyma tissue of any sort but does have very high levels of tannin. Also, no aril is present. These features, presumably, render the fruits unpalatable to most animals.

Note — This species is extremely variable, principally in three characters: 1) degree of pubescence of young aerial parts, 2) number of leaflets, 3) length of inflorescence. Some geographical/character correlation is apparent, the most pronounced being that of leaflet number. At the Philippines end of the range there is a tendency towards the 3–5-foliolate state whereas specimens with 9+ leaflets predominate at the Sumatra end of the range.

Two forms can be recognized, as follows:

a. forma **chrysogyne**

Young parts glabrous or puberulous on axes and leaflet midrib and costae only.
Distribution — Throughout range of species.

b. forma **velutina** (Ridley) T.P. Clark

Pseudoclausena chrysogyne (Miq.) T.P. Clark forma *velutina* (Ridley) T.P. Clark, Blumea 38 (1994) 294. — *Walsura velutina* Ridley, Bull. Misc. Info. Kew (1930) 371.

Young parts (incl. leaf lamina) velutinous.
Distribution — Borneo, Philippines (Mindanao).

CIPADESSA

Cipadessa Blume, Bijdr. (1825) 162; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 93; T.D. Penn., Blumea 22 (1975) 479.
Mallea A. Juss., Bull. Soc. Sci. Géol. 23 (1830) 236.

Small trees. *Indumentum* of simple hairs. *Leaves* imparipinnate. *Inflorescences* polygamous, axillary thyrses. *Calyx* 5-lobed in apical half. *Petals* 5 (or 6), free, valvate. *Filaments* alternatively long and short, connate near base, terminated by a pair of narrowly lanceolate to filiform or erose appendages; anthers 10, acute, inserted between the appendages, pubescent. *Disk* patelliform. *Ovary* 5- (or 6-)locular; locules with 1 (or 2) collateral ovules; style short, stout, columnar, swollen stylehead with 5 (or 6) stigmatic lobes. *Fruit* a globular drupe with 5 (or 6) pyrenes, each 1- (or 2-)seeded; endocarp bony. *Seeds* orange-segment-shaped, exarillate; testa thin, membraneous; embryo embedded in endosperm; cotyledons thin, flat, collateral; radicle superior, long exserted. Germination phanerocotylar, the eophylls opposite or subopposite, ternate to trifoliolate.

Distribution — Monotypic.

Note — In floral features, *Cipadessa* is very similar to *Walsura* and, as in so many other parts of the family, the distinctive characters are in the fruits which are totally different in these genera. Moreover, the rachis of the leaf, and occasionally the leaflets, bear extrafloral nectaries.

Fig. 9. *Cipadessa baccifera* (Roth) Miq. a. Habit; b. half flower; c, d. outside of staminal tube; e. fruit, cross section; f. pyrene (a, e, f: *Dilmy 975*; b–d: *Dilmy 1124*). Drawing R. van Crevel.

Cipadessa baccifera (Roth) Miq.

Cipadessa baccifera (Roth) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 6; Kurz, For. Fl. Burma 1 (1877) 214; C.DC. in DC., Monogr. Phan. 1 (1878) 426; Theob. in Mason, Burma, ed. 4, 2 (1883) 582, incl. var. *rothii* Theob. & var. *integerrima* Theob.; Backer, Schoolfl. Java (1911) 203; Rehd. & Wils. in Sarg., Pl. Wils. 2 (1914) 159, incl. var. *sinensis* Rehd. & Wils.; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 358; Craib, Fl. Siam. Enum. 1 (1926) 251; Hend., Gard. Bull. Str. Settl. 7 (1933) 94; Merr., Contr. Arnold Arbor. 8 (1934) 81; Elmer, Leafl. Philipp. Bot. 9 (1937) 3348; Pellegr. in Fl. Indo-Chine, Suppl. (1946) 722, incl. var. *cinerascens* (Pellegr.) Pellegr.; How & Chen, Acta Phytotax. Sin. 4 (1955) 34; Narayana, J. Ind. Bot. Soc. 37 (1958) 147; Backer & Bakh. f., Fl. Java 2 (1965) 118; T.D. Penn., Blumea 22 (1975) 479, f. 8d; Sald. & Nicols., Fl. Hassan Dist. (1976) 394; Corner, Seeds Dicots 1 (1976) 188; Wu, Fl. Yunnan. 1 (1977) 219, t. 51, f. 3–7; Whitmore, Enum. Flow. Pl. Nepal 2 (1979) 85; Mabb. in Tree Fl. Malaya 4 (1989) 239; Hô, Ill. Fl. Vietnam 2, 1 (1992) 484, incl. var. *cinerascens*. — *Melia baccifera* Roth, Nov. Sp. Pl. Ind. Or. (1821) 215; DC., Prodr. 1 (1824) 622; Spreng., Syst. Veg. 3 (1826) 67; G.Don, Gen. Syst. 1 (1831) 681.

Ekebergia indica Roxb. [Hort. Beng. (1814) 33, nom. nud.]; Hoffmans., Verz. Suppl. 2 (1828) 9, 34; Roxb., Fl. Ind., ed. Carey 2 (1832) 392.

[*Mallea parviflora* Moon, Cat. Pl. Ceyl. (1824) 35, nom. nud.]

Cipadessa fruticosa Blume, Bijdr. (1825) 162; G.Don, Gen. Syst. 1 (1831) 680; Miq., Fl. Ind. Bat. 1, 2 (1859) 533; Hiern in Hook. f., Fl. Brit. India 1 (1875) 545; Trimen, Handb. Fl. Ceylon 1 (1893) 245; Talbot, Trees Bomb. (1894) 74; ibid., ed. 2 (1902) 108; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 158, A–D; ibid., ed. 2, 19b1 (1940) t. 21, A–D; Cooke, Fl. Bomb. 1 (1902) 206; Prain, Beng. Pl. (1903) 219; Brandis, Indian Trees (1906) 137; Talbot, For. Fl. Bomb. 1 (1909) 227, t. 135; Pellegr. in Fl. Indo-Chine 1 (1911) 782, t. 85, f. 1–6, incl. var. *cinerascens* Pellegr.; Koord., Exk. Fl. Java 2 (1912) 438; Atlas (1913) t. 167; Gamble, Fl. Madras 1 (1915) 176.

[*Mallea baccata* Heyne ex Wall., Cat. (1829) n. 1256, nom. nud.]

[*Ekebergia integerrima* Wall., Cat. (1829) n. 1257, nom. nud.] — *Mallea integerrima* Wall. ex Voigt, Hort. Suburb. Calc. (1845) 134.

[*Mallea montana* Herb. Madras ex Wall., Cat. (1829) n. 1256D, nom. nud.]

Mallea rothii A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 222, t. 13, f. 6, nom. illeg.; Wight & Arn., Prodr. (1834) 118; Grah., Cat. Pl. Bomb. (1839) 31; Voigt, Hort. Suburb. Calc. (1845) 134; M. Roem., Synops. Monogr. 1 (1846) 91; Thwaites, Enum. (1858) 60; Dalz. & Gibs., Bomb. Fl. (1861) 37; Drury, Handb. 1 (1864) 163; Bedd., Fl. Sylv. (1871) liv, t. 8, f. 5.

Mallea subscandens Teijsm. & Binn., Nat. Tijds. Ned.-Indië 25 (1863) 422. — *Cipadessa subscandens* (Teijsm. & Binn.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 7.

Cipadessa warburgii Perkins, Notizbl. Bot. Gart. Berlin 4 (1903) 79; Fragm. (1904) 30; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 359.

Rhus blinii Lév., Fl. Kouy-Tcheou (1915) 411.

Cipadessa sinensis (Rehd. & Wils.) Hand.-Mazz., Vegetationsbild. 20, 7 (1930) [9], sine basion.; E. Salisb., Ind. Kew., Suppl. 10 (1947) 52.

Cipadessa cinerascens (Pellegr.) Hand.-Mazz., Symb. Sin. 7 (1933) 632; Chun, Sunyatsenia 4 (1940) 236; How & Chen, Acta Phytotax. Sin. 4 (1955) 33; Lauener, Notes Roy. Bot. Gard. Edinb. 27 (1967) 271; Anon., Ic. Corm. Sin. 2 (1972) 572, 2873; Wu, Fl. Yunnan. 1 (1977), t. 51, 1, 2.

Shrubs or small trees, 2–6(–9) m tall, sometimes ± subscandent. Bark smooth, mottled, finely lenticellate; wood hard, white to slightly pink, odourless and tasteless (Elmer). Leafy *twigs* 3–5 mm diam., lenticellate, ± finely pubescent, sericeous at apex. *Leaves* 10–28 cm long; paler abaxially, petiole to 6 cm, terete, pubescent. *Leaflets* 4–6(–7) on each side, opposite, 2–11 by 1.5–4 cm, narrowly oblong to ovate, entire or irregularly dentate towards apex, ± pubescent on both surfaces at least on veins, but especially abaxially; apex acuminate; base weakly asymmetric, acute or rarely ± rounded; veins c. 6–9 on each side, arcuate, prominent abaxially; petiolule to 8 mm (–2 cm in apical leaflet),

or absent. *Thyrses* 8–21 cm long, branched at apex of rachis 4–12 cm long, ascendant, silky pubescent; bracts 1.5 mm long, subulate, sericeous; bracteoles c. 1 mm, sericeous; pseudopedicel c. 3 mm, sericeous. *Calyx* lobes c. 1 mm long, triangular, spreading, pubescent, persistent in fruit. *Petals* 3.5–4 mm long, ovate, greenish or cream to white, densely pubescent without. *Filaments* 1.5–2.5 mm long, anthers yellow. *Ovary* 5–6-angular, glabrous, style c. 0.7 mm, glabrous. *Drupe* c. 5 mm diam., longitudinally grooved, reddish brown. 2n = 28, 56. — **Fig. 9.**

Distribution — Tropical and subtropical Asia from Nepal, India and Sri Lanka to southern China, Indochina and Thailand; in *Malesia:* Sumatra, Malay Peninsula (Kedah), Java, Philippines (Luzon, Mindanao), Celebes, Lesser Sunda Islands (Bali, Lombok, Flores, Sumbawa, Timor). Cultivated in Hawaii and, under glass, in Europe.

Habitat & Ecology — Forest edges and thickets, ravines and crevices in rocks, including limestone (Thailand), to 2100 m altitude. It is a common treelet with apparently continuous flowering and fruiting typical of early successional forest-edge plants.

Vernacular names — Sumatra: kundulen-pamal (Karo); Sumbawa: kajah (?kaju = tree) keluting; Philippines: banaibag, bicum (Ig.), taboat (Bag.).

Uses — Anon., l.c. (1972) reports (sub *Cipadessa cinerascens*) that the seeds, which contain some 11% oil, are used in soap manufacture in China.

Notes — 1. Occasionally, collectors have confused this plant with *Brucea sumatrana* Roxb. (*Simaroubaceae*), but that plant may be readily distinguished by its silky yellow indumentum.

2. According to Shaanker et al. [Ann. Rev. Ecol. Syst. 19 (1988) 180, under '*Cyppadessa*'), the seed-ovule ratio is 0.82, the number of seeds per fruit being 3.73–0.93.

3. Lersten & Pohl [Ann. Bot. 56 (1985) 363] report 25–35 small ellipsoid extrafloral nectaries on the abaxial surface of each leaf-rachis and occasionally leaflets of specimens from Sri Lanka, India, China and Malesia. Nectar is secreted until leaf maturity.

4. Near Bangalore, the plant is badly affected by phytophagous *Eutetranychus orientalis* (Klein), the spider mite [K. Banu & G.P. Channabasavanna, Mysore J. Agric. Sci. 6 (1972) 253–268].

Tribus Guareeae

Guareeae T.D. Penn. in T.D. Penn. & Styles, Blumea 22 (1975) 489.[1]

Leaves pinnate. *Indumentum* of simple, rarely stellate, hairs. Plants dioecious or *flowers* hermaphrodite. Staminal tube complete, nearly always cylindrical, lobed or not; anthers nearly always within throat. Stylehead discoid, more rarely capitate. *Fruit* nearly always a loculicidal capsule. *Seed* with an aril or sarcotesta, without endosperm; cotyledons plano-convex, collateral or superposed, rarely oblique.

1) The new tribes described in Pennington & Styles are attributable to Pennington alone as they were originally described in his unpublished doctoral thesis (B.T. Styles, pers. comm.; Fl. Neotrop., Meliac., passim).

Distribution — Nine genera, pantropical. Two genera restricted to tropical America (*Cabralea* A. Juss., *Ruagea* Karst.), two to Africa (*Heckeldora* Pierre, *Turraeanthus* Baill.), three to Indomalesia and western Pacific (*Anthocarapa, Chisocheton, Dysoxylum*), one to tropical Australia (*Synoum* A. Juss.). *Guarea* L. is a genus of 40 species of tropical America and Africa and is closely allied to the two large genera of Indomalesia, *Dysoxylum* and *Chisocheton*, together making the core of this tribe, the other genera being monotypic or oligotypic satellites.

DYSOXYLUM

Dysoxylum Blume, Bijdr. (1825) 172; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 160, t. 35 f. F–J; T.D. Penn., Blumea 22 (1975) 504, f. 14a–d, excl. syn. *Harpagonia* Noronha (= *Psychotria* L., *Rubiaceae*); Mabb. in Fl. Nouv.-Caléd. et Dép. 15 (1988) 23; in Tree Fl. Malaya 4 (1989) 239, f. 6.

Epicharis Blume, Bijdr. (1825) 166; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 167, t. 35 f. K, N–Q.

Didymocheton Blume, Bijdr. (1825) 177; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 156, t. 35 f. L, M.

Goniocheton Blume, Bijdr. (1825) 177.

Hartighsea A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 237; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 227.

Cambania Comm. ex M. Roem., Synops. Monogr. 1 (1846) 83, 102.

[*Prasoxylon* M. Roem., Synops. Monogr. 1 (1846) 83, 101, nom. superfl.]

Macrocheton (Blume) M. Roem., Synops. Monogr. 1 (1846) 84, 104 ('*Macrochiton*').

[*Disyphonia* Griff., Notul. 4 (1854) 504, nom. provis.]

Piptosaccos Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 415.

Pseudocarapa Hemsl. in Hook., Ic. Pl. (1884) 1, t. 1458; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 139; T.D. Penn., Blumea 22 (1975) 502, f. 13d; cf. Large & Mabb., Bot. J. Linn. Soc. 116 (1994) 1.

Meliadelpha Radlk., Sitzungsber. Math.-Phys. Kl. Kön. Bayer. Akad. Wiss. München 20 (1891) 331.

[*Alliaria* [Rumph. ex] Kuntze, Rev. Gen. 1 (1891) 108, nom. superfl., non Fabr. (1759), nec Scop. (1760).]

Trees or shrubs, often very pachycaul, dioecious, more rarely with hermaphrodite flowers. *Indumentum* of simple hairs, very rarely with stellate ones. *Leaves* spirally arranged, rarely opposite, pinnate, occasionally with tardily developed apical leaflets, very rarely with winged rachis. *Inflorescences* thyrses to racemose or spicate, sometimes reduced to fascicles or solitary flowers, axillary, ramiflorous or cauliflorous, sometimes with conspicuous bracteoles and these sometimes transitional to separate sepals. *Calyx* of free sepals or, more usually, a 3–5(–6)-lobed tube. *Petals* 3–6, free or adnate to base of staminal tube. *Staminal tube* cylindrical to urceolate, margin entire, lobed or tipped with 6–10(–13) appendages; anthers 6–16, within throat of tube, pollen sometimes shed in tetrads. *Disk* free, tubular though sometimes short or even subannular, margin sometimes lobed. *Ovary* 2–6-locular, each locule with 1 or 2 seeds; stylehead capitate to discoid. *Fruit* a 2–6-valved capsule, each valve with 1 or 2 seeds. *Seeds* anatropous, usually with aril or sarcotesta.

Distribution — About 80 species of tropical E Asia from India and Sri Lanka (3) to S China, Indochina, throughout *Malesia* (including Christmas Island, 1) to the Pacific

south to Australia (14), New Caledonia (9), Norfolk Is. (1), Lord Howe Is. (1, endemic), New Zealand (1, endemic) and east to Niue (1).

Dysoxylum shows the greatest distribution of any Indopacific genus in the family with high levels of endemism in New Guinea (16 of 28; cf. Borneo with 2 of 22, Malay Peninsula with 2 of 17), Fiji (7 of 9) and New Caledonia (8 of 9), demonstrating a distinctly austral richness by comparison with its ally *Chisocheton* (*Guareeae*) and the other large genus in Malesia, *Aglaia* (*Aglaieae*). Unlike those then, *Dysoxylum* cannot be said to be essentially Malesian and has to be understood in a Pacific context.

Habitat & Ecology — Exclusively wet-forest trees with one rheophyte, *D. angustifolium* King, of the Malay Peninsula. Altitudes 0–2580 m.

Notes — 1. The range of form from pachycaul to leptocaul is mirrored in both *Aglaia* and *Chisocheton*, though the range of structure of the flowers and leaves is much greater in *Dysoxylum* than in *Aglaia*, where, however, fruit form is more varied.

2. *Dysoxylum* differs from *Chisocheton* in its anatropous seeds. Otherwise there are great similarities in those species of *Chisocheton* with a prominent disk and no pseudogemmula, notably those in sect. *Clemensia*, where there are fruits with stinging hairs similar to those in *D. sessile* for instance.

3. For a summary of the limonoids in the genus and their biological activity, see S.A. Adesanya et al., J. Nat. Prod. 54 (1991) 1588.

4. Certain species, formerly excluded as the genus *Didymocheton* are notable for their spirally arranged sepals transitional to bracteoles. Spirals are otherwise found in meliaceous flowers only in certain species of sect. *Holopentas* of *Chisocheton* where the corolla may appear to have 2 whorls (the formerly segregated genus *Megaphyllaea*), though species with transitional forms link that to 1-whorled ones. The species with separate sepals are closely allied to the austral taxa in the genus, notably the species of New Caledonia and New Zealand. It is also notable that the most pachycaul species, *D. sessile* of the Moluccas has such a calyx. Sect. *Cyrtochiton*, by contrast, is poorly distributed outside Indomalesia.

Systematics — *Dysoxylum* sect. *Cyrtochiton* is marked by spike-like apical buds, 4-merous uniform flowers, usually in spicate inflorescences and (?) sarcotestal seeds with green cotyledons. The only examples of opposite leaves in the family are here, too. *Dysoxylum cyrtobotryum* in this group is replaced by *D. latifolium* to the east and this in turn by allied taxa in the western Pacific, while, to the west, there are other vicariant taxa.

A similar pattern is seen in the *D. cauliflorum* group, with *D. cauliforum* in Sumatra, the Malay Peninsula and Borneo, *D. cumingianum* largely in the Philippines and *D. pettigrewianum* in New Guinea and tropical Australia, and also in sect. *Cyrtochiton* with *D. grande* from continental Asia to Borneo, *D. oppositifolium* in the Philippines to Queensland, as well as *D. rugulosum* and *D. brachybotrys* west of Wallace's Line, *D. enantiophyllum* in New Guinea. *D. pachyrhache* in Borneo and *D. kauiense* in New Guinea are a similar pair, as are *D. magnificum* and *D. brassii* (sect. *Dysoxylum*). Yet another pair with similar distribution relationships in sect. *Dysoxylum* is *D. crassum* (Borneo) and *D. inopinatum* (New Guinea).

In *D. mollissimum* (sect. *Dysoxylum*) the variation pattern is best represented as subspecific taxa either side of Wallace's Line, the second being more or less Malesian, the first extending far into continental Asia on the one hand, to the western Pacific on the other.

The complex species *D. excelsum* and *D. alliaceum* are very variable and closely allied to one another, though they appear to have more or less distinct 'satellite' taxa, *D. klanderi* F. Muell. in Queensland, *D. hongkongense* (Tutcher) Merr. in China outside Malesia. Some of the most widespread species, *D. arborescens*, *D. parasiticum* and *D. gaudichaudianum*, seem rather uniform by comparison.

By contrast, some species are very restricted. The rheophyte *D. angustifolium* is found only in the Pahang basin of the Malay Peninsula. Unlike this species or species in other genera that are restricted to e.g. peatswamp forests (*Sandoricum beccarianum*, *Chisocheton amabilis*), riparian forest (*Sandoricum borneense*), or ultramafic rocks (*Walsura monophylla*), others have no obvious ecological restrictions, e.g. *D. boridianum* from the village of Boridi, New Guinea.

The distinction between *Dysoxylum* and *Guarea* (Neotropics and Africa) is rather weak. The disk alleged to separate the two, in being characteristic of *Dysoxylum*, is scarcely formed in certain *Dysoxylum* species. Both genera are separable from *Chisocheton* in that the latter is marked by its orthotropous, rather than (hemi-)anatropous, seeds; many *Guarea* species have the pseudogemmula typical of *Chisocheton* species. The whole group is closely interrelated and the peripheral genera are very closely allied too, *Anthocarapa* Pierre (q.v.) being particularly weakly differentiated from *Dysoxylum*.

KEY TO THE SECTIONS

1a. Bud of fist-shaped young leaves ..... sect. **Dysoxylum** *(p. 66)*
b. Bud of stiletto-like young leaves ..... sect. **Cyrtochiton** *(p. 116)*

KEY TO THE SPECIES

(excluding four insufficiently known species)

1a. Leaves with conspicuously winged rachis — New Guinea ..... **6. D. alatum**
b. Leaf rachis unwinged, rarely weakly so 2
2a. Leaves opposite 3
b. Leaves spirally arranged 5
3a. Leaves pubescent, at least abaxially ..... **37. D. oppositifolium**
b. Leaves glabrous 4
4a. Venation obscure .. **45. D. acutangulum** (see also **41. D. enantiophyllum**)
b. Costae and intercostae prominent ..... **46. D. carolinae**
5a. Terminal leaflet present 6
b. Terminal leaflet absent; small 'spike' or scar ± present 17

6a. Inflorescences axillary 7
b. Inflorescences ramiflorous to cauliflorous 12
7a. Calyx splitting into lobes at anthesis 8
b. Calyx of discrete sepals 9
8a. Leaves up to 4-jugate; petals 5; fruit smooth ..... **24. D. arborescens**
b. Leaves up to 8-jugate; petals 5; fruit cerebriform, tomentose .. **5. D. setosum**
c. Leaves 5–8-jugate; petals 4; fruits smooth ..... **13. D. mollissimum**
9a. Indumentum of simple and stellate hairs; sepaloid bracteoles absent ..... **4. D. stellatopuberulum**
b. Indumentum of simple hairs, sepaloid bracteoles present 10
10a. Leaves up to 3- (or 4-)jugate, treelet ..... **3. D. nutans**
b. Leaves with more leaflets 11
11a. Costae c. 16 on each side; inflorescence and fruit strigose-irritant; pachycaul treelet to 6 m ..... **1. D. sessile**
b. Costae c. 10–12 on each side; inflorescences not strigose ..... **2. D. gaudichaudianum**
12a. Calyx 7–15 mm long ..... **7. D. parasiticum**
b. Calyx less than 4 mm long 13
13a. Leaves up to 8-jugate, leaflets strongly asymmetric; inflorescences ramiflorous; fruits silky hairy ..... **8. D. densiflorum**
b. Leaves 3–5-jugate; inflorescences ramiflorous to cauliflorous; fruits ± glabrous 14
14a. Staminal tube ± hairy. — Thailand to S Philippines ..... **11. D. cauliflorum**
b. Staminal tube glabrous 15
15a. Inflorescences 3–8(–12) mm long; treelet. — New Guinea ..... **12. D. brevipaniculum**
b. Inflorescences much longer; trees 16
16a. Inflorescences finely adpressed hairy. — E Malesia .. **9. D. pettigrewianum**
b. Inflorescences densely strigose hairy. — C Malesia ... **10. D. cumingianum**
17a. Apical bud not spike-like, with young leaves like clenched fists 18
b. Apical bud spike-like or stiletto-shaped (sect. *Cyrtochiton*) 33
18a. Leaves strictly paripinnate with terminal pair of leaflets 19
b. Leaves not so 25
19a. Leaves 10–14-jugate ..... **15. D. variabile**
b. Leaves up to 7-jugate 20
20a. Costae c. 5–7 on each side, obscure; petals 4. — Malay Peninsula ..... **20. D. dumosum**
b. Costae c. 6–9 on each side, obscure; petals 5. — Borneo ... **19. D. crassum**
c. Costae more, conspicuous. — Philippines, New Guinea 21
21a. Staminal tube unceolate (to subcylindrical); pollen shed in tetrads. — New Guinea ..... **18. D. inopinatum**
b. Staminal tube cylindrical, pollen grains shed singly 22
22a. Petals at least 8 mm long 23
b. Petals up to 5 mm long. — New Guinea 24

23a. Petals 4 — Philippines ..... **23. D. pauciflorum**
b. Petals 5; capsule smooth. — New Guinea ..... **21. D. sparsiflorum**
c. Petals 5; capsule lenticellate-pustular. — New Guinea ... **22. D. boridianum**
24a. Leaves 4–6-jugate; inflorescences 4–13 cm long; petals up to 2 mm long ..... **16. D. papuanum**
b. Leaves 5–7-jugate; inflorescences to 35 cm long; petals c. 4.5 mm long ..... **14. D. annae**
c. Leaves 3- or 4-jugate; inflorescences 4–9 cm long; petals at least 4 mm long ... **17. D. yunzaingense**
25a. Leaves glabrous, venation markedly scalariform; petals 5 ... **25. D. rigidum**
b. Leaves glabrous or not, venation different 26
26a. Leaflets narrowly elliptic (rheophyte). — Malay Peninsula **29. D. angustifolium**
b. Leaflets not so 27
27a. Shoots and abaxial surface of leaflets densely reddish velutinous ..... **30. D. magnificum**
b. Leaflets different 28
28a. Leaflets yellowish pilose abaxially; inflorescence spicate .. **33. D. papillosum**
b. Leaflets and inflorescence different 29
29a. Costae up to 12 on each side 30
b. Costae (14) 15 on each side. — New Guinea 31
30a. Leaflets asymmetric at base, rarely subequal, shiny adaxially; bracteoles inconspicuous; calyx and corolla glabrous; infructescence ± branched; whole plant, or at least fruit, smelling of onions ..... **26. D. alliaceum**
b. Leaflets ± symmetric, not markedly shiny adaxially; bracteoles conspicuous; calyx and corolla pubescent; infructescence ± unbranched; whole plant not smelling of onions ..... **27. D. excelsum**
31a. Bracts 5–10 by 1–2.5 mm; treelet with flagelliform inflorescences ..... **28. D. phaeotrichum**
b. Bracts up to 3.5 mm long; inflorescences to 20 cm long 32
32a. Petals up to 9 mm long ..... **32. D. randianum**
b. Petals more than 13 mm long ..... **31. D. brassii**
33a. Abaxial surface of leaflets brown-tomentose 34
b. Abaxial surface of leaflets glabrous to subglabrous 35
34a. Leaves 6–9-jugate; leaflets with 23–25 costae ..... **35. D. grande**
b. Leaves 2–4-jugate; leaflets with 15–18 costae ..... **36. D. pachyrhache**
35a. Intercostal venation scarcely distinguishable from costae .. **44. D. flavescens**
b. Costae distinct; intercostal venation often obscure 36
36a. Leaves paripinnate, 2–4(–5)-jugate, glabrous to puberulous 37
b. Leaves ± imparipinnate with ± alternate leaflets 38
37a. Petals 4–5 mm long; staminal tube crenulate. — New Guinea ..... **41. D. enantiophyllum**
b. Petals 8 mm long; staminal tube crenate to toothed ..... **42. D. rugulosum**
c. Petals 6 mm long; staminal tube truncate. — Borneo .. **43. D. brachybotrys**

38a. Leaflets to 30 by 10 cm; thyrses to 25 cm, with spreading branches ..... **34. D. macrocarpum**
b. Leaflets smaller; thyrses subspiciform 39
39a. Leaflets minutely rugulose; costae 12–15(–18). — New Guinea ..... **40. D. kaniense**
b. Leaflets not rugulose; costae 7–13 40
40a. Calyx c. 4 mm long. — West of Wallace's Line ..... **38. D. cyrtobotryum**
b. Calyx c. 1.5 mm long. — East of Wallace's Line ..... **39. D. latifolium**

Section Dysoxylum

Dysoxylum sect. *Dysoxylum*; Blume, Bijdr. (1825) 174.
Dysoxylum sect. *Macrocheton* Blume, Bijdr. (1825) 175; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 8, 18. — *Macrocheton* ('*Macrochiton*') sect. *Macrocheton* ('*Eumacrochiton*') M. Roem., Synops. Monogr. 1 (1846) 104.
Macrocheton ('*Macrochiton*') sect. *Schoutensia* M. Roem., Synops. Monogr. 1 (1846) 104, excl. basion.
Dysoxylum sect. *Didymocheton* (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 8, 13. — *Didymocheton* Blume, Bijdr. (1825) 177. — *Alliaria* sect. *Didymocheton* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 108.
Dysoxylum sect. *Prasoxylon* (M. Roem.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 9, 21, nom. superfl. pro sect. *Dysoxylum*. — *Prasoxylon* M. Roem., Synops. Monogr. 1 (1846) 83, 101.
Dysoxylum sect. *Goniocheton* (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 9, 24. — *Goniocheton* Blume, Bijdr. (1825) 177.
Dysoxylum sect. *Epicharis* (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 7, 9. — *Epicharis* Blume, Bijdr. (1825) 166.
[*Dysoxylum* sect. *Siphonodiscus* F. Muell., Fragm. Phyt. Austral. 9 (1875) 134, nom. provis.]
Dysoxylum sect. *Cleistocalyx* F. Muell., Melb. Chem. Drug. (1881) 33; Trans. Bot. Soc. Edinb. 14 (1883) 369.
Alliaria Kuntze sect. *Typalliaria* Kuntze in T. Post & Kuntze, Lex. Gen. Phan. (1903) 18.

Apical buds with fist-like young leaves. Inflorescences usually branched. Flowers (3–)4–6-merous. Seeds usually bitegmic, often arillate.

1. Dysoxylum sessile Miq.

Dysoxylum sessile Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 15; C.DC. in DC., Monogr. Phan. 1 (1878) 527. — *Alliaria sessilis* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109. — *Didymocheton sessile* (Miq.) Kosterm., Reinwardtia 7 (1969) 437, excl. syn. *Dysoxylum hirtum* Ridley.
Dysoxylum urens [Teijsm. & Binn., Cat. Hort. Bogor. (1866) 391, nom. nud.] Valeton, Ic. Bog. (1897) t. 12; Hochr., Pl. Bogor. Exsicc. (1904) 72; Cat. Bogor. Nov. 2 (1905) 53; Briq., Mém. Inst. Nat. Genev. 24 (1935) 54; Mabb. & Hallé, Gard. Bull. Sing. 29 (1977) 177.

Pachycaul tree to 6 m, unbranched or sparingly fastigiately branched. *Leaves* 70 cm–1 m, imparipinnate, 8–10-jugate, bunched at tips of stout shoots, drying yellowish; petiole 20–35 mm, 4–5 mm diam., flattened or grooved adaxially in sicco, especially towards base, ± yellow-brown strigose, base swollen; rachis 3–4 mm diam., terete, ± densely yellow-brown strigose. *Leaflets* opposite, sessile, the most distal the largest, 24–30 by 5–10 cm, oblong to narrowly lanceolate, the most proximal ovate, ± glabrous to ± sparsely strigose adaxially except for densely yellow-brown strigose midrib,

conspicuously and sometimes densely strigose abaxially, apex acuminate, acumen to 15 mm, base obtuse, weakly asymmetric, venation brochidodrome, costae c. 16 on each side, arcuate. *Thyrses* to 80 cm, the flowers on short branches to 8.5 cm or in fascicles

Fig. 10. *Dysoxylum sessile* Miq. Habit. Bogor, Botanic Garden. Photograph D.J. Mabberley, August 1981.

of up to 9, borne on the distal 2/3 of axis; axis pendent, c. 3 mm diam., densely yellow-strigose; bracts 5–7 mm long, narrowly triangular, densely adpressed pilose. *Flowers* sessile, hyacinth-scented (Valeton, l.c.).; bracteoles c. 7, orbicular, passing imperceptibly into sepals. *Sepals* 5, 2–3 mm long, margin imbricate, adpressed pilose abaxially, membraneous and long-cilate, base somewhat concave; calyx cupular, c. 3 mm long and diam. *Petals* 5, c. 14 mm long, 2.5–3 mm wide, linear-lanceolate, valvate, ± weakly imbricate at apices, fleshy, adpressed strigose without, adnate to staminal tube in proximal quarter. *Staminal tube* glabrous, margin ± divided into 10 lobes or erose; anthers 10, c. 1 mm long, narrowly oblong, locellate, glabrous, attached c. 1.5 mm inside tube, subsessile. *Disk* c. 2 mm long, cylindrical, glabrous, membraneous, margin ± erose. *Ovary* 5-locular, each locule 1-ovulate, with dense strigae 2 mm long adpressed and basifugal; style terete, glabrous; stylehead capitate-truncate. *Capsule* c. 4 cm diam., flattened-globose, 5-lobed, densely yellow-ochre, strigose when young, densely short-tomentose, cerebriform in sicco at maturity, the strigae irritant. *Seeds* up to 5, c. 1 cm long, plano-convex, ?arillate. — **Fig. 10.**

Distribution — *Malesia:* N & C Moluccas (Morotai, Bacan, Obi, Buru, Ceram, Ambon, Saparua).

Habitat — ?Rain forest to 1100 m altitude.

Note — This remarkable plant, which is still cultivated at Bogor, has, in its pachycaul form, long inflorescences and fruits with irritant hairs, the appearance of a species of *Chisocheton* sect. *Clemensia*. Furthermore, the locellate anthers are found otherwise only in that genus in the family. Although it differs in its calyx and anatropous rather than orthotropous seeds, it and sect. *Clemensia* possibly represent relics of the stock from which these two genera diverged.

2. **Dysoxylum gaudichaudianum** (A. Juss.) Miq.

Dysoxylum gaudichaudianum (A. Juss.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 15; C.DC. in DC., Monogr. Phan. 1 (1878) 518; Adelb., Blumea 6 (1948) 316: Backer & Bakh. f., Fl. Java 2 (1965) 121, incl. 'var. *pubescens*', nom. non rite publ.; Henty, Bot. Bull. Lae 12 (1980) 100, t. 35. — *Didymocheton gaudichaudianum* A. Juss., Bull. Sci. Nat. Géol. 23 (1830) page after 239 ('238'); Linnaea 6 lit. (1831) 113; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 231, 272; M. Roem., Synops. Monogr. 1 (1846) 105; Miq., Fl. Ind. Bat. 1, 2 (1859) 540; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157; Kosterm., Reinwardtia 7 (1969) 436; Du Puy in Fl. Austral. 50 (1993) 297. — *Alliaria gaudichaudiana* (A. Juss.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Turraea decandra Blanco, Fl. Filip. (1837) 347. — *Dysoxylum decandrum* (Blanco) Merr., Philipp. Govt. Lab. Bur. Bull. 27 (1905) 30; Fl. Manila (1912) 276; Philipp. J. Sc., Bot. 11 (1916) 279; Sp. Blanc. (1918) 209; Guerr., Dept. Agr. Nat. Res. Bur. For. Bull. 22, 3 (1921) 197; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 363; Briq., Mém. Inst. Nat. Genev. 24 (1935) 53; Elmer, Leafl. Philipp. Bot. 9 (1937) 3362; Quis., Med. Pl. Philipp. (1951) 479, 1036; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 338, t. 258. — *Didymocheton decandrum* (Blanco) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157; Bot. Jahrb. 72 (1942) 189.

Turraea virens auct. non L.: Blanco, Fl. Filip., ed. 2 (1845) 243; ed. 3, 2 (1878) 88, t. 130.

Dysoxylum rufum (Rich.) Benth., Fl. Austral. 1 (1863) 382, quoad var. *glabrescens* Benth.; F. Muell., Fragm. Phytogr. Austral. 5 (1865/6) 145, quoad var. *glabrescens*; C.DC. in DC., Monogr. Phan. 1 (1878) 519, quoad var. *glabrescens*; F.M. Bailey, Queensl. Fl. 1 (1899) 231, quoad var. *glabrescens*.

[*Dysoxylum pubescens* Teijsm. & Binn., Cat. Hort. Bogor. (1866) 211, nom. nud.]

[*Dysoxylum macrophyllum* Teijsm. & Binn., l.c., nom. nud.]

Dysoxylum amooroides Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 16; C.DC. in DC., Monogr. Phan. 1 (1878) 518; Naves in Blanco, Fl. Filip., ed. 3 (?1878) t. 130; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 84, incl. var. *otophorum* (Miq.) Koord. & Valeton & var. *typicum* Koord. & Valeton ('*typica*'), nom. superfl.; Koord., Minah. (1898) 386; K. Schum., Notizbl. Bot. Gart. Berlin 2 (1898) 125; K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 380; C.DC., Bull. Herb. Boiss. II, 3 (1903) 178 & 6 (1906) 167; Perkins, Fragm. Fl. Philipp. (1904) 31; Hochr., Pl. Bogor. Exsicc. (1904) 70, incl. var. *otophorum* & var. *pubescens*; Cat. Bogor. Nov. 2 (1905) 11, 17, incl. var. *otophorum* & var. *pubescens*; Ridley, J. Str. Br. Roy. As. Soc. 45 (1906) 181; Backer, Fl. Batavia (1907) 272, incl. var. *otophorum*; Schoolfl. Java (1911) 203; Koord., Exk. Fl. Java 2 (1912) 442; Atlas 1 (1913) t. 173; Briq., Mém. Inst. Nat. Genev. 24 (1935) 50, incl. var. *pubescens*; C.T. White, N. Queensl. Nat. 3 (1935) 34, excl. syn. *D. cerebriforme* F.M. Bailey; Proc. Roy. Soc. Queensl. 53 (1942) 211; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 893. — *Alliaria amooroides* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109 ('*ammoorodes*'). — *Didymocheton amooroides* (Miq.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157.

[*Goniocheton aurantiacum* Zipp. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 16, nom. in syn.]

Dysoxylum otophorum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 15; C.DC. in DC., Monogr. Phan. 1 (1878) 517 ('*othophorum*'). — *Alliaria otophora* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum spanoghei Miq., op. cit. (1868) 14; C.DC., l.c. — *Alliaria spanoghei* (Miq.) Kuntze, l.c. — *Didymocheton spanoghei* (Miq.) Harms, l.c.

Dysoxylum blancoi Vidal, Cat. Pl. Manila (1880) 22 ('*Disoxylum*'); Revist. Monog. (1880) 4, n.v.; Sin. Pl. Len. Filip. Atl. (1883) ind. xix, t. 29A.

[*Dysoxylum salutare* Fern.-Vill. in Blanco, Fl. Filip., ed. 3, Nov. App. (1880) 42, nom. superfl.]

Dysoxylum vestitum Warb., Bot. Jahrb. 13 (1891) 343.

Dysoxylum maota Reinecke, Bot. Jahrb. 25 (1898) 643; Rech., Denkschr. Akad. Wiss. Wien 85 (1910) 296 cum tab.; Setch., Carn. Inst. Wash. Publ. 341 (1924) 81, t. 3; Christoph., Bull. Bish. Mus. 128 (1935) 115; A.C. Smith, Contr. U.S. Nat. Herb. 30 (1952) 511. — *Didymocheton maota* (Reinecke) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157. (Syn. nov.).

Dysoxylum betchei C.DC., Bull. Herb. Boiss. II, 3 (1903) 178, quoad flor. — *Didymocheton betchei* (C.DC.) Harms, l.c.

?*Dysoxylum funkii* C.DC., Bull. Herb. Boiss., II, 6 (1906) 981.

Dysoxylum quaifei C.DC., Bull. Herb. Boiss. II, 6 (1906) 982.

Dysoxylum albiflorum C.DC., Ann. Cons. Jard. Bot. Genev. 15/16 (1912) 245. — *Didymocheton albiflorum* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157.

Dysoxylum bakerarum Guillaumin, J. Linn. Soc., Bot. 51 (1938) 550. (Syn. nov.).

Dysoxylum intermedium Merr. & L.M. Perry, J. Arnold Arbor. 29 (1948) 157. (Syn. nov.).

[*Arbor sebi* Rumph., Herb. Amb. 7 (1755) 7.]

Trees to 36 m; bole to 80 cm diam., fluted; buttresses to 2.5 m tall, 3.5 m out, concave, plank-like. Bark grey-brown, smooth to scaling, lenticellate to densely pustular; inner bark creamish, flecked orange; sapwood creamish. Crown rather irregular, of massive branches and twigs with large terminal rosettes of leaves; twigs conspicuously cicatrose, cicatrices to 1 cm, scutellar; leafy twigs to 2 cm diam., ± lenticellate with wide pith sometimes inhabited by ants. Apical buds with fist-shaped young leaves. *Leaves* 30–125 cm, imparipinnate, up to 14-jugate, the distal leaflets developing some time after the more proximal, drying yellowish; petiole 3–8 cm, 3–5 mm diam., terete to flattened adaxially, glabrescent to softly pubescent, base swollen; rachis 4–5 mm diam., glabrescent to ± pubescent. *Leaflets* opposite to subopposite, the subterminal the largest, to 30 by 10 cm, the apical and most distal sometimes falling before developing, the more proximal smaller and even substipuloid in form, oblong-ovate, glabrous or weakly pubescent on midrib adaxially, glabrescent to softly pubescent or even tomen-

tose abaxially, base strongly asymmetric obtuse to subcordate distally, acute to cuneate proximally, joining midrib up to 1 cm distal to junction of obtuse side and midrib, apex acuminate, nerves c. 10–12 on one side, 8–10 on other, prominent on both surfaces in sicco, arcuate, not linked at margin; petiolules 0–3 mm. *Thyrses* to 70 cm, axillary to supra-axillary, pendent, 1–2-branched, the primary to 20 cm, the more distal shorter, the secondary to 1.5 cm bearing fascicles of sessile flowers; bracts c. 3 mm long, long-triangular, pubescent. *Flowers* white to creamy yellow, somewhat foetid (*Lasianthus*-like, Mabberley); bracteoles c. 5, imbricate, orbicular, grading imperceptibly into sepals. *Sepals* 5, 2 mm long, adpressed pubescent, abaxially concave at base, margin ciliate; calyx cupular, c. 2.5 mm long and diam. *Petals* (4 or) 5, c. 12–14 by 2.5–3 mm, linear-lanceolate, valvate, sometimes weakly imbricate at apices, adpressed pubescent without, glabrous within, adnate to staminal tube in proximal half. *Staminal tube* ± sericeous on both sides, margin with 10 ± bifid lobes; anthers (9 or) 10(–15), c. 1 mm long, narrowly oblong, locellate, glabrous, attached in notches between lobes, ± protruding from tube, subsessile. *Disk* c. 2.5 mm long, cylindrical, subglabrous to adpressed pubescent especially within, margin ± 5-lobed to irregularly crenate. *Ovary* densely long-sericeous, 5-locular, each locule 2-ovulate; style terete, long sericeous in lower 3/4; stylehead short-cylindrical to subdiscoid. *Fruit* c. 3 cm diam., flattened globose, 5-lobed, densely yellow-brown tomentose, cerebriform in sicco. *Seeds* up to 10, red (raphe-aril cum sarcotesta), c. 1 cm long, plano-convex, borne on white carpel walls. *Seedlings* with simple leaves.

Distribution — Christmas Island (Indian Ocean), Queensland, Solomon Islands, New Hebrides, Samoa; *Malesia:* Java, Philippines (Luzon, Masbate, Mindanao, Palawan), Celebes, Lesser Sunda Islands (Sumbawa, Flores, Timor), Moluccas (Ceram, Tenimbar, Aru), New Guinea, Bismarck Archipelago.

Habitat & Ecology — Primary and secondary forest including swamp forest, bamboo woodlands and forests on limestone, to 1800 m altitude. A common tree, the seeds taken by pigeons (Christopherson, l.c.).

Dysoxylum gaudichaudianum, besides the introduced *Melia azedarach* L., is the only member of the family to be found on Christmas Island, where, according to Ridley (l.c.) the seeds are eaten by birds though the ground beneath the trees was said to be strewn with them. The species is one of the most widely distributed in the genus, extending out into the Pacific, though its absence from Fiji is not readily explained. It ('*D. caulostachyum*') is the major component of the successionally most advanced forest in the Krakatau group [H. Tagawa et al., Vegetatio 60 (1985) 131]. The chief dispersers appear to be two species of pigeon and a bulbul. Maturing fruits develop a fishy aroma attractive to insects, hastening the decay process [R.J. Whittaker & B.D. Turner, J. Trop. Ecol. 10 (1994) 167].

Vernacular names — Tai (Sund.), doja kedoja (Jav.), ketudjeuh (Mad.), ki agáru (Pang.), agúio, agúiu, malabangan, malabaga, taliktan (Pamp.), anamangtang, bakúgan, bundúgun, buntóg, buntógan, bongliu, bolong-tambag, manangtang, makasisi, palo-hambobokag (Bik.), basiloág, pasiloág (Ilk.), íkuo, íguo, kuging, tadiang-kalubán, taliktan (Tag.), malaadúas, paluahan (P. Bis.), pamatágin (Ibn.), tauing-tauing

(Mbo.), sarecab (Bag.); mamalapa (Alf. Minah.); hapelewa, kakarawa, ngando (Flores), keolmansa (Dawan); babi (baruga), damlo (Usino), djiet, nitjiri (Kebar), gima (Rawa), maraira (Roro), mellum (Jal.), naukisua (New Brit.), sengandote (Biak), serajama, serakaputi, (Manikiong), sipi (Bembi). Official common name in Philippines: igio.

Uses — The tree has medicinal properties and is well known in the Philippines, where its uses were recorded in the seventeenth century by Mercado [see Fern.-Vill. in Blanco, Fl. Filip., ed. 3, 4, 2 (1880) VI, 17] as Aguio or Iguio, and it may be sometimes planted [Merr., Fl. Manila (1912) 276]. It has been widely used as an emetic (K. Heyne, l.c., Quisumbing, l.c.) but it has been recorded that in Papua New Guinea two deaths resulted from taking an infusion of the bark in coconut milk for this purpose (Henty). Infusions are said to be piscicidal and insecticidal in the Trobriand Islands (Henty).

Notes — 1. De Wit [Rumph. Mem. Vol. (1959) 416] has identified *Arbor nussalavica* Rumph., Herb. Amb. 7 (1755) 14, t. 8 f. 2 with *D. gaudichaudianum*, following Merrill's earlier suggestion that the plant is a species of *Dysoxylum*. However, the tetramerous ramiflorous fruits are more reminiscent of *D. parasiticum*, where I have placed Rumphius's plant tentatively. Rumphius's *Arbor sebi*, with vernacular name kidoja seems to belong here.

2. To the synonymy established by Bakhuizen f. (q.v.) and C.T. White (q.v.) I have added merely the Samoan *D. maota* as understood by A.C. Smith, *D. bakerarum* from Vanuatu, and *D. intermedium* from New Guinea, which fall in the range of variation in New Guinea and the Solomon Islands. I have excluded *D. cerebriforme*, included by White, as this is *D. setosum*.

3. Dysoxylum nutans (Blume) Miq.

Dysoxylum nutans (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 17, incl. var. *sumatranum* Miq. & f. *tomentosum* Miq.; C.DC. in DC., Monogr. Phan. 1 (1878) 520, incl. var. *sumatranum* Miq. & var. *tomentosum* (Miq.) C.DC.; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 90, incl. var. *tomentosum* (Miq.) C.DC.; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 161, f. L, M; Hochr., Pl. Exsicc. Bogor. (1904) 71; Cat. Bogor. Nov. 2 (1905) 8; Backer, Schoolfl. Java (1911) 203; Koord., Exk. Fl. Java 2 (1912) 203; Fl. Tjibodas (1918) 128; Baker f., J. Bot. Lond. 62, Suppl. (1924) 17; Briq., Mém. Inst. Nat. Genev. 24 (1935) 52; Backer & Bakh. f., Fl. Java 2 (1965) 122, incl. var. *tomentosum* (Miq.) C.DC. — *Didymocheton nutans* Blume, Bijdr. (1825) 177; Spreng., Syst. Veg. 4, 2 (1827) 253; G. Don, Gen. Syst. 1 (1831) 685; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 231, t. 16, f. 14; Span., Linnaea 15 (1841) 183 ('*natans*'); M. Roem., Synops. Monogr. 1 (1846) 105; Miq., Fl. Ind. Bat. 1, 2 (1859) 540; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 35, f. L, M. — *Alliaria nutans* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 108/9.

Didymocheton leschenaultianum A. Juss., Bull. Sci. Nat. Géol. 23 (1830) p. after 239 ('238'); Linnaea 6 lit. (1831) 112; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 231, 271; M. Roem., Synops. Monogr. 1 (1846) 105; Miq., Fl. Ind. Bat. 1, 2 (1859) 540. — *Dysoxylum leschenaultianum* (A. Juss.) Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 94; Backer, Schoolfl. Java (1911) 203; Koord., Exk. Fl. Java 2 (1912) 442; Backer & Bakh. f., Fl. Java 2 (1965) 122.

[*Melia pubescens* Reinw. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 17, nom. in syn.]

[*Didymocheton suaveolens* Blume ex Miq., l.c., nom. in syn.]

Dysoxylum hirsutum C.DC., Meded. Rijks Herb. Leiden 22 (1914) 7.

Dysoxylum paucijugum C.DC., op. cit. (1914) 8.

Dysoxylum rufum auct. non Benth.: C.DC., op. cit. (1914) 8.

Bush with fastigiate branching or small tree to 6 m; bole to 5 cm diam. Bark grey-brown, smooth to finely cracked; inner bark creamish, flecked white. Leafy *twigs* c. 4–5 mm diam., glabrescent to ± densely pilose. Apical buds with fist-shaped young leaves, densely brown pilose. *Leaves* 20–50 cm, imparipinnate, (1–)2–3(–4)-jugate, drying yellowish; petiole 6–10 cm, c. 2 mm diam., terete, glabrescent to ± densely pilose, base slightly swollen; rachis c. 2 mm diam., glabrescent to ± pilose. *Leaflets* all developing together, opposite, the terminal three the largest, to 25 by 8 cm, the more proximal smaller and even substipuloid in form, obovate-oblong to elliptic, glabrescent or finely sericeous on midrib adaxially, glabrescent to ± densely pilose abaxially, base weakly asymmetric in lateral ones, acute, symmetrical and attenuate in apical one, apex ± bluntly acuminate, costae c. 9–11 on each side, arcuate, not directly linked at margin; petiolule 0–2 mm (–12 mm on apical leaflet), ± pilose. *Thyrses* axillary or in axils of cicatrices of lately fallen leaves, 10–30 cm, ± squarrose, 0- or 1-branched, the proximal branches to 6 cm, passing imperceptibly distally into fascicles of sessile flowers; rachis c. 1.5 mm diam., ± pilose; bracts c. 2 mm long, narrowly triangular, ± densely adpressed pilose. *Flowers* white to cream, solitary or in fascicles of up to 7; bracteoles 2 or 3, 2–3 mm long, triangular to subsepaloid, densely pilose. *Calyx* cupular to salviform, c. 2–2.5 mm diam., sepals 5, imbricate, c. 2–2.5 mm long, united at base, ± densely pilose, ciliate at margin, the free lobes ovate or rounded. *Petals* 5, 16–19 by 2.5 mm, valvate, fleshy, adpressed pubescent to pilose without, glabrous within, adnate to staminal tube in proximal half. *Staminal tube* ± densely sericeous without, long-villous within, margin 10-lobed, each lobe irregularly bifid or toothed; anthers (9 or) 10, c. 1 mm long, narrowly oblong, ± locellate, glabrous, attached in notches between lobes, ± partially protruding from tube, subsessile. *Disk* c. 3 mm long, cylindrical, subglabrous or somewhat pubescent either or both within and without, irregulary c. 5-lobed or crenate. *Ovary* densely long-strigose, 5-locular, each locule 2-ovulate; style terete, long sericeous in lower 5/6; stylehead short-cylindrical. *Fruit* c. 2 cm long, subspherical to ellipsoid, usually ± beaked, especially when young, orange-red, densely pilose, cerebriform in sicco, 5-valved. *Seeds* up to 10, usually fewer, c. 13 mm long, plano-convex, red, borne on white carpel walls.

Distribution — *Malesia:* Sumatra (?, based only on Korthals's specimens, localizations of which are often inaccurate), Java, Celebes, Lesser Sunda Islands (Bali, Sumbawa, Flores), Moluccas (Sula Islands). Cultivated at Bogor.

Habitat & Ecology — Primary and secondary forest including that on ultrabasics and limestone, to 1600 m altitude, apparently very common as an understorey tree in Java and parts of Celebes, especially near streams. Flowering all year round.

Vernacular names — Gegertako, kokossan monjet, pinango (Java), lonca ibo (Uma, Celebes), pu'u puor (Flores).

Notes — 1. Specimens with somewhat lobed leaflets have been collected in both Java and Celebes. Specimens from Celebes tend to have smaller calyces with more triangular lobes, and to be, in general, more strongly pilose than the bulk of the Javanese specimens. However, densely hairy specimens are well known from Java and specimens

with intermediate calyx characters have been collected in Flores and in the Sula Islands. Nevertheless, the matter is worth further investigation.

2. This plant has a great superficial resemblance to *D. hornei* Gillespie of Fiji, but that differs in its smaller number of stamens (6) and carpels (3).

4. Dysoxylum stellatopuberulum C.DC.

Dysoxylum stellatopuberulum C.DC., Bull. Herb. Boiss. II, 3 (1903) 167. — *Didymocheton stellatopuberulum* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157.
Dysoxylum hirtum Ridley, Trans. Linn. Soc., Bot. 9 (1916) 26. — *Didymocheton hirtum* (Ridley) Harms, Bot. Jahrb. 72 (1942) 191. (Syn. nov.).
Didymocheton carrii Harms, Bot. Jahrb. 72 (1942) 190. (Syn. nov.).

Tree to 40 m, but at higher altitudes much less and flowering when young; bole to 80 cm diam.; buttresses to 1.8 m tall, 70 cm out, 3 cm thick. Bark smooth to longitudinally fissured with somewhat recurved flakes, brown; inner bark whitish; sapwood white; heartwood redbrown. *Twigs* stout, scutellar-cicatrose, ± lenticellate. Leafy twigs 4–10 mm diam. (stout at high altitudes), sometimes inhabited by ants, ± tomentellous, the trichomes basally tufted stellate. Apical buds fist-shaped, subcircinate, ± densely stellate-pilose. *Leaves* 25–35 cm, imparipinnate, 3- or 4-jugate, the apical leaflet sometimes lost; a pair of substipular proximal leaflets or their scars sometimes present; petiole 5–9 cm, 2–3 mm diam., angled or at least flattened or grooved adaxially in sicco, ± stellate-pubescent, base swollen. *Leaflets* opposite to subopposite, ± coriaceous particularly at altitude, subglabrous to scattered stellate-hairy especially on veins, the apical the largest, to 22 by 10.5 cm, elliptic oblong, base symmetric, acute to cuneate, apex acuminate, the laterals oblong (distal), 10–17 by 5–8 cm, to ovate (proximal) when smaller, the pseudostipular pair c. 1 cm long, ovate, c. 1 cm from axil, bases asymmetric, apices acute to acuminate, costae c. 14 or 15 on each side, linked at margin, venation brochidodrome; petiolules 0–5(–8) mm, that of apical leaflet to 12 mm, (shortest at altitude), ± stellate pubescent. *Inflorescences* spikes to 3 cm (female) or basally branched panicles to 7 cm, appearing as fascicles of up to 4 sparsely branched panicles, these secondary branches to 1.5 cm, axillary or in axils of cicatrices on twigs to 1.5 cm diam. ± stellate-pubescent; bracts lanceolate, 2–3 mm long; pedicels 0–2 mm. *Calyx* c. 4 mm long and diam., cupular; sepals free, imbricate, 2.5–4 mm diam., suborbicular or semiorbicular, ± stellate-tomentose without. *Petals* 5, 12–17 by 3.5 mm, oblong-obtuse, imbricate, weakly connate to staminal tube, ± densely stellate-sericeous without, cream. *Staminal tube* glabrous or adpressed sericeous (the trichomes simple) at base without margin crenulate; anthers (9) 10, c. 2 mm long, linear-oblong, basally attached, the apices scarcely exserted, glabrous. *Disk* c. 3 mm long, cupular, ± stellate-strigose, especially within and on irregularly crenate margin. *Ovary* densely strigose, 5-locular, each locule ?-ovulate; style densely strigose in proximal 2/3; stylehead short-cylindrical to subdiscoid, its flanks scalloped by anther impressions. *Capsule* to at least 5.5 cm diam., spherical to subpyriform, 5-sutured, densely minutely stellate-tomentose, with scattered larger stellate hairs, particulary around persistent style, brown. *Seeds* 3 cm long and diam., trigonal.

Distribution — *Malesia:* New Guinea (Irian Jaya: Vogelkop, Geelvink Bay, Jayapura; Papua New Guinea: Central Province).

Habitat — Rain forest to 1800 m altitude.

Vernacular names — New Guinea: kiriopi, sewawarioram (Japen), lesai (Momi), njavro (Nemo).

Notes — 1. I have not seen mature ovaries or good seeds, the only adequate fruiting collection known to me, *BW 9108* (L), having completely empty fruits. This phenomenon is not uncommon in *Canarium* (*Burseraceae*, Leenhouts).

2. This is the only species of *Dysoxylum* with stellate hairs, which are known elsewhere in the Malesian members of the tribe in sect. *Rhetinosperma* of *Chisocheton*. Those are readily distinguished from this species by their pseudogemmulae and larger thyrsoid inflorescences. The sporadic occurrence of stellate hairs is also found in *Aphanamixis*, forms of *A. polystachya* being the only ones with them in the genus.

3. I have reduced *Dysoxylum hirtum* with its rather hairy morphology and *Didymocheton carrii* with its rather coriaceous leaves to *Dysoxylum stellatopuberulum* as there are intermediate specimens.

5. **Dysoxylum setosum** (Span.) Miq.

Dysoxylum setosum (Span.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 13; C.DC. in DC., Monogr. Phan. 1 (1878) 500. — *Epicharis ? setosa* Span., Linnaea 15 (1841) 182; M. Roem., Synops. Monogr. 1 (1846) 103; Miq., Fl. Ind. Bat. 1, 2 (1859) 539. — *Alliaria setosa* (Span.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

[*Didymocheton pruriens* Zipp. ex Span., Linnaea 15 (1841) 183, nom. nud.; ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 13 nom. in syn.]

Dysoxylum cerebriforme F.M. Bailey, Dept. Agr. Queensl. Bot. Bull. 14 (1896) 7, t. 1, 2; Queensl. Agr. J. n.s. 2 (1914) 73, t. 36. (Syn. nov.).

Dysoxylum magnifolium C.DC., Bull. Herb. Boiss. II, 3 (1903) 166. (Syn. nov.).

Dysoxylum lactiflorum Baker f., J. Bot. Lond. 61, Suppl. (1923) 8. (Syn. nov.).

Dysoxylum sericiflorum C.T. White, N. Queensl. Nat. 3 (1935) 35. (Syn. nov.).

Dysoxylum amooroides auct. non Miq. (1868): C.T. White, op. cit. 34, quoad syn. *Dysoxylum cerebriforme*.

Dysoxylum lamproanthum Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 308. (Syn. nov.).

Dysoxylum tafaense Merr. & L.M. Perry, op. cit. (1940) 310. (Syn. nov.).

Dysoxylum thaumasianthum Harms, Bot. Jahrb. 72 (1942) 202. (Syn. nov.).

Tree to 30 m, but at high altitudes much less; bole to 50 cm diam.; buttresses to 20 cm tall and 30 cm out. Bark grey, vertically fissured; inner bark brownish, sometimes with weak white latex; sapwood cream or white; heartwood red, hard, with conspicuous medullary rays. *Twigs* stout, erect, cicatrose, greyish with large raised, pustular lenticels. Leafy twigs 6–11 mm diam., lenticellate, ± yellow-brown velutinous, sometimes with white latex or inhabited by ants. Apical buds with fist-shaped young leaves. *Leaves* 20–75 cm, imparipinnate and less often paripinnate on same tree, or apical leaflet lost, up to 6-jugate, less at high altitudes; petiole 8–20 cm, 3–5 mm diam., terete to flattened adaxially, glabrescent to pubescent or even tomentose. *Leaflets* opposite to subopposite, the subterminal the largest, to 28 by 10 cm, elliptic-ovate, the more proximal smaller, ovate, subglabrous or sparsely sericeous adaxially with domatia, to softly

fulvous pubescent on veins adaxially and ± over whole abaxial surface, the indumentum often with longer paler hairs scattered in it, ± coriaceous, particularly at high altitudes, bases ± weakly asymmetric, acute to cuneate, apex acuminate, often abruptly so, costae c. 11–15 on each side, prominent abaxially in sicco, arcuate, linked at margin, venation brochidodrome; petiolules 0–6 mm, ± pubescent. *Thyrses* to c. 25 cm long, often less, axillary to supra-axillary, sometimes borne in axils of lately fallen leaves, ± erect, 1- or 2-branched, ± pyramidal, the axes ± fulvous pubescent, the primary branches to 6 cm long, the secondary to 5 mm or fascicles crowded distally on primary; bracts 1–3 cm, narrowly lanceolate to foliose when up to 1 cm wide and petiolate, ± fulvous pubescent; pedicels 5–8 mm; bracteoles 1–3, to 4 mm long, narrowly triangular. *Flowers* sweetly-scented (sweet *Compositae*, e.g. *Helenium*, Mabberley). Pseudopedicel 2–4 mm, swollen proximally near articulation, ± fulvous pubescent. *Calyx* 5–8 mm long and diam., cupular, splitting at anthesis into (4) 5 (6) rather irregular lobes, 1–4 mm, ± densely adpressed pubescent without. *Petals* (4–)5(–6), 7–10 mm long, densely sericeous without, creamy white, waxy, valvate, adnate in up to proximal third to staminal tube. *Staminal tube* glabrous to ± pilose, especially at base within, white, with 10(–12) rather irregular lobes, sometimes emarginate, reflexed at anthesis; anthers 10(–12), c. 2 mm long, oblong, ± included. *Disk* c. 5 mm long, glabrous or sometimes pilose within, margin irregularly 5-lobed to crenulate. *Ovary* densely pilose, (4- or) 5-locular, each locule 2-ovulate; style pilose in proximal half; stylehead short-cylindrical to subdiscoid. *Capsule* to 3 cm long, c. 4 cm diam., ellipsoid to depressed globose, usually rostrate, yellow-brown, cerebriform in sicco with a dense tawny tomentum, usually mixed with paler, deciduous, irritant hairs c. 2 mm long, (4–)5(–6)-locular, each locule with 1 or 2 seeds. *Seeds* trigonal, testa orange, with aril enveloping proximal third.

Distribution — Australia (N Queensland); *Malesia:* Lesser Sunda Islands (Timor), New Guinea.

Habitat & Ecology — Forests, evergreen and semi-deciduous from sealevel to 2580 m altitude, including those on coral and other limestones and secondary forest.

Vernacular names — New Guinea: laba (Telefomin), pal-ja, parth (Wabag), mama (Enga).

Uses — Although this tree is widespread and has a beautifully marked red timber, it has been recorded as used only for houseposts in New Guinea.

Notes — 1. Specimens from high altitudes in New Guinea have fewer leaflets, which are coriaceous, and the apical one is often lost before developing. In the highest montane localities in that island, the leaves and inflorescences are densely covered with hairs but the irritant hairs of both the vegetative parts and the fruits typical of some of the lowland specimens are generally absent.

2. As Miquel (l.c.) points out, this species links his sections *Epicharis* and *Didymocheton*, having the calyx of the first and fruit of the second.

3. Although confused with specimens referable to *Dysoxylum sessile*, the type of *Epicharis ? setosa* is clearly identical with other material from Timor and that of the widespread tree in New Guinea, known as *D. magnifolium* or *D. lactiflorum* (which are based on the same Forbes gathering). *Dysoxylum cerebriforme*, described originally from

fruiting specimens, with its hairs of two lengths and its stubby buds, belongs here and not to *D. gaudichaudianum* ('*D. amooroides*') as proposed by C.T. White, who gave the name *D. sericiflorum* to the flowering material associated with the fruits by Bailey. *Dysoxylum tafaense* has the longest bracts, though a wide range of bract size is found in the specimens included here.

6. **Dysoxylum alatum** Harms

Dysoxylum alatum Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1901) 380; Kosterm., Reinwardtia 7 (1969) 435. — *Epicharis alata* (Harms) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 169.

Tree to 10 m (30 m, Harms); bole to 28 cm diam., but often flowering as a small treelet. Bark smooth to finely cracked, creamish to brown; inner bark creamy yellow to pink with orange-brown streaks; sapwood cream; heartwood redbrown. Apical buds with fist-shaped pubescent young leaves. Leafy *twigs* to 6 mm diam., lenticellate. *Leaves* 35–70 cm, imparipinnate, 5–8-jugate, apical leaflets developing tardily; petiole 7–10 cm, 2–4 mm diam., terete to flattened adaxially, swollen at base, lenticellate, glabrous to sparsely pubescent; rachis winged, wings forming ± right-angled triangles, with the right angle proximal to a pair of leaflets and the long side concurrent with rachis to next pair, the short side to 8 mm; apical leaflet 18–24 by 6–9 cm, obovate, apex gradually acuminate, acumen to 1 cm, base acute to cuneate. *Leaflets* glabrous to ± pubescent, petiolules 1–2 mm; lateral leaflets opposite, the most distal 14–23 by 5–8 cm, more proximal pairs successively smaller, ovate to suborbicular, apices acuminate, bases ± asymmetric, rounded to acute, venation brochidodrome, costae c. 12–14 on each side, arcuate. *Inflorescences* of coffee-scented (Mabberley) flowers borne on trunk and branches, very short. *Calyx* 7–8 mm long, campanulate, coriaceous, ± glabrous, closed in bud, margin with five acute teeth. *Petals* 13–14 mm long, linear-lanceolate, acute, thickened at apices, sericeous abaxially, apparently free from tube, white. *Staminal tube* white, with 10(?) emarginate appendages; anthers 10 inserted between bases of appendages. *Disk* short, tubular. *Ovary* 5-angled, ovoid, hairy, each locule with 2 superposed ovules; style hairy in proximal half. *Fruits* apparently solitary, pedicellate, to 3 cm diam., dark brown velutinous. *Seeds* 3 or 4 (?5), plano-convex, ?arillate.

Distribution — *Malesia:* New Guinea (Irian Jaya: Fakfak; Papua New Guinea: E Sepik & Madang Provinces).

Habitat — Rain forest including regrowth to 300 m altitude. Apparently common in some areas as near Aiome, Madang (Coode & Katik) but rarely collected.

Vernacular names — Amsusu (Jal), kissaik (Kaigorin), kummummu (Rawa), kwassap (Usino), sarumo (Bembi), taganna (teste Lauterbach).

Note — The description of the flowers is largely taken from Harms (l.c.).

7. **Dysoxylum parasiticum** (Osb.) Kosterm.

Dysoxylum parasiticum (Osb.) Kosterm., Reinwardtia 7 (1966) 247; Backer & Bakh.f., Fl. Java 3 (1968) 654. — *Melia parasitica* Osb., Dagb. Ostind. Resa (1757) 278; Merr., Amer. J. Bot. 3

(1916) 582, excl. syn.; Pl. Life Pac. World (1945) 94, excl. syn.; J. Arnold Arbor. 33 (1952) 229, excl. syn.; Whitmore, Trop. Rain For. Far East (1975) 25, excl. syn. — *Lansium parasiticum* (Osb.) Sahni & Bennet, Ind. For. 100 (1974) 202, excl. syn.

[*Azedarach ramiflora* Noronha, Verh. Bat. Genoot., ed. 5. 1 (1791) art. 4, 5, nomen.]

Guarea cauliflora Reinw. ex Blume, Cat. Buitenzorg (1823) 64, nomen; Flora 7 (1824) 290, nomen; Spreng., Syst. Veg. 4 (1827) 251. — *Epicharis cauliflora* Blume, Bijdr. (1825) 166; G. Don, Gen. Syst. 1 (1831) 684; M. Roem., Synops. Monogr. 1 (1846) 102; Miq., Fl. Ind. Bat. 1, 2 (1859) 539.

Epicharis sericea Blume, l.c.; G.Don, l.c.; M. Roem., l.c.; Miq., l.c. — *Guarea sericea* (Blume) Spreng., l.c. — *Dysoxylum sericeum* (Blume) Adelb., Blumea 6 (1948) 316; Backer & Bakh. f., Fl. Java 2 (1965) 122. (Syn. nov.).

Epicharis speciosa A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 239; Linnaea 6 lit. (1831) 112; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 229, 266, t. 15, f. 12; Deene., Herb. Timor. Descr. (1835) 116; M. Roem., l.c.; Miq., l.c. — *Dysoxylum speciosum* (A. Juss.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 11; C.DC. in DC., Monogr. Phan. 1 (1878) 500; Briq., Mém. Inst. Nat. Genev. 24 (1935) 49. — *Alliaria speciosa* (A. Juss.) Kuntze, Rev. Gen. Pl. 1 (1891) 109. (Syn. nov.).

Piptosaccos hypophyllantha Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 415; cf. Fedtsch., Svensk Bot. Tidskr. 19 (1925) 490 cum tab.; Bull. Jard. Bot. Princ. U.R.S.S. 25 (1926) 152. (Syn. nov.).

Dysoxylum ramiflorum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 10, nom. illeg. (*Epicharis cauliflora* & *E. sericea* in syn.); C.DC., op.cit. (1878) 498; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 39; Hochr., Pl. Bogor. Exsicc. (1904) 72; Backer, Schoolfl. Java (1911) 205; Koord., Exk. Fl. Java 2 (1912) 440; Atlas 1 (1913) t. 172; Fl. Tjibodas (1918) 129; Briq., Mém. Inst. Nat. Genev. 24 (1935) 48; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 895. — *Alliaria ramiflora* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum caulostachyum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 12; C.DC. in DC., Monogr. Phan. 1 (1878) 499; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 34; Koord., Minah. (1898) 386; Hochr., Pl. Bogor. Exsicc. (1904) 71; Backer, Schoolfl. Java (1911) 205; Koord., Exk. Fl. Java 2 (1912) 440; Atlas 1 (1913) t. 99, 100; Ridley, Trans. Linn. Soc. Lond., Bot. II, 9 (1916) 25; Schimper, Pflanzengeogr., ed. 3 (1935) t. 147, 148; Briq., Mém. Inst. Nat. Genev. 24 (1935) 49; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 300; Adelb., Blumea 6 (1948) 316; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 893; Backer & Bakh. f., Fl. Java 2 (1965) 122; Whitmore, Trop. Rain For. Far East (1975) t. 2.14. — *Alliaria caulostachya* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109. — *Epicharis caulostachya* (Miq.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168.

[*Epicharis trichostyla* Zipp. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 12, pro syn.]

Dysoxylum schiffneri F. Muell., Melb. Chem. Drugg. (1881) 53; Trans. Bot. Soc. Edinb. 14 (1883) 369; F.M. Bailey, Rep. Bot. Bell.-Ker Exp. (1889) 34; Queensl. Fl. 1 (1899) 228. — *Epicharis schiffneri* (F. Muell.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940). (Syn. nov.).

Dysoxylum novoguineense Warb., Bot. Jahrb. 13 (1891) 344; Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 380. (Syn. nov.).

Dysoxylum megalanthum Hemsl., J. Linn. Soc. 30 (1894) 211, t. 9. — *Epicharis megalantha* (Hemsl.) Harms, l.c. (Syn. nov.).

[*Epicharis ramiflora* Pierre, Fl. For. Cochinch. (1897) sub. t. 348, nom. illeg.]

Dysoxylum longicalicinum C.DC., Bull. Herb. Boiss. II, 3 (1903) 165. — *Epicharis longicalicina* (C.DC.) Harms, l.c. (Syn. nov.).

Dysoxylum longipetalum C.DC., l.c.; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 300. — *Epicharis longipetala* (C.DC.) Harms, l.c. (Syn. nov.).

Dysoxylum leytense Merr., Philipp. J. Sc., Bot. 8 (1913) 376; Enum. Philipp. Flow. Pl. 2 (1923) 364; Briq., Mém. Inst. Nat. Genev. 24 (1935) 53; Elmer, Leafl. Philipp. Bot. (1937) 3371; Chang, Prov. Pingt. Agr. For. Assoc. 19 (1977) 16. — *Epicharis leytensis* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 380. (Syn. nov.).

Dysoxylum roemeri C.DC., Nova Guinea, Bot. 8 (1914) 1012. (Syn. nov.).

Dysoxylum longiflorum Merr., Philipp. J. Sc., Bot. 9 (1915) 538; Enum. Philipp. Flow. Pl. 2 (1923) 364; Elmer, Leafl. Philipp. Bot. (1937) 3371. — *Epicharis longiflora* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 380. (Syn. nov.).

Dysoxylum robinsonii Merr., Philipp. J. Sc., Bot. 9 (1915) 540; Enum. Philipp. Flow. Pl. 2 (1923) 365. — *Epicharis robinsonii* (Merr.) Harms, l.c. (Syn. nov.).

Dysoxylum rumphii Merr., Philipp. J. Sc., Bot. 11 (1916) 278. — *Epicharis rumphii* (Merr.) Harms, l.c. (Syn. nov.).

Dysoxylum densevestitum C.T. White, Queensl. Bot. Bull. 22 (1920) 6, cum tab. — *Epicharis densevestita* (C.T. White) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 169. (Syn. nov.).

[*Dysoxylum fragrans* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 365, pro syn.; Elmer, Leafl. Philipp. Bot. (1937) 3365, descr. angl.] (Syn. nov.).

[*Dysoxylum glochidioides* Elmer ex Merr., l.c., pro syn.]

Dysoxylum brachypodum Baker f., J. Bot. Lond. 62, Suppl. (1924) 17. — *Epicharis brachypoda* (Baker f.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 169. (Syn. nov.).

Dysoxylum loheri Merr., Philipp. J. Sc. 27 (1925) 28. — *Epicharis loheri* (Merr.) Harms, l.c. (Syn. nov.).

Dysoxylum fissum C.T. White & Francis ex Lane-Poole, Rep. For. Res. Terr. Pap. New Guinea (1925) 101; C.T. White & Francis, Proc. Roy. Soc. Queensl. 38 (1927) 234. (Syn. nov.).

Dysoxylum no. 296, Lane-Poole, op.cit. 103.

Dysoxylum callianthum Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 300. — *Epicharis calliantha* (Merr. & L.M. Perry) Harms, Bot. Jahrb. 72 (1942) 203. (Syn. nov.).

Dysoxylum richardsonianum Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 307. (Syn. nov.).

Epicharis hyacinthodora Harms, Bot. Jahrb. 72 (1942) 204. (Syn. nov.).

[?*Arbor nussalavica* Rumph., Herb. Amb. 7 (1755) 14, t. 8, f. 2.]

Tree 20–27(–36) m, somewhat pachycaul, sometimes flowering as an unbranched or sparsely branched treelet; bole to 45(–60) cm diam. Buttresses to 1.5 m tall and out, concave, when present then bole fluted. Bark smooth, yellowish, with scattered pustular lenticels to flaking grey-brown with inflorescence bosses to 8 by 8 cm; inner bark pale brown with orange streaks; sapwood white; heartwood red. *Twigs* suberect, brownish to pinkish grey with brown lenticels and conspicuous scutellar cicatrices. Leafy twigs 5–12 mm diam., erect, pithy, ± fulvous pubescent to tomentose. Apical buds with fist-shaped young leaves, ± fulvous-tomentose. *Leaves* 1–1.5 m when mature, imparipinnate, to 17(–19)-jugate, the apical portion developing throughout a season and the terminal leaflet sometimes undeveloped or lost, bunched at twig apices; petiole 8–12 cm, 3–7 mm diam., terete, swollen and flattened to grooved adaxially at base, ± pubescent, lenticellate; rachis 2–6 mm diam., terete to angled (in sicco), ± pubescent, often brown-tomentose. *Leaflets* opposite to subopposite, dull dark green adaxially, paler abaxially, chartaceous when dry, subglabrous to densely fulvous tomentose abaxially and on veins adaxially, the largest the more apical, to 19(–28) by 6(–8) cm, narrowly elliptic to oblong, the most proximal smallest, subelliptic to suborbicular, apices ± acuminate, bases obtuse to rounded, ± asymmetric, venation brochidodrome, conspicuously reticulate, prominent abaxially, costae c. 15–20 on each side, arcuate, petiolules 3–8 mm, –18 mm on terminal leaflet, ± densely tomentose. *Racemes* to 30 cm long, pendent, borne in fascicles on bosses on the bole, major branches and twigs, and/or in axils where usually solitary, sometimes few-flowered or even flowers solitary, sweetly scented (hyacinths, Docters van Leeuwen), rachis subglabrous to densely pilose or tomentose; bracts c. 1 mm long, triangular rarely to 8 mm, lanceolate, foliaceous; pedicels c. 6–13 mm, subglabrous to densely adpressed pubescent. *Calyx* c. 7–15 mm long, cylindrical, cream, subglabrous or with ciliate margin to densely adpressed pubescent,

margin irregularly (2–)3–5-lobed, lobes c. 4–6 mm long, triangular, reflexed at anthesis. *Petals* 4(or 5), 15–20(–28) mm long, linear lanceolate, imbricate at apices where thicker, white or creamish, ± adpressed pubescent without especially apically. *Staminal tube* glabrous or rarely sparsely hirtellous within or without, margin with 8 (10, 12) lobes, truncate, emarginate or shallowly bifid, reflexed at anthesis; anthers 8 (10, 12), c. 1.2 mm long, oblong, brown. *Disk* 4–5 mm long, cylindrical, glabrous, margin truncate to crenulate. *Ovary* densely adpressed pilose, 4-(or 5-)locular, each locule with 1 or 2 superposed ovules; style densely adpressed pilose in proximal half; stylehead subcapitate to discoid. *Infructescences* to 30 cm long or fruits solitary. *Fruits* to 4 cm diam., obovoid-globose to flattened-globose, conspicuously 4- or 5-ribbed, redbrown, dehiscing starwise, carpels white within. *Seeds* 2–5, c. 2 cm long, brownish black with basal orange-red aril. — **Fig. 11.**

Distribution — Taiwan (Lan Yü), Solomon Islands and *Malesia:* Sumatra, E Borneo, Java, Philippines (Leyte, Luzon, Mindanao, Palawan, Siargao), Celebes, Lesser Sunda Islands (Lombok, Sumba, Sumbawa, Flores, Tanimbar, Timor), Moluccas (Ambon, Bacan, Buru, Ceram, Halmahera, Kei and Sulu Islands), New Guinea, Bismarck Archipelago.

Fig. 11. *Dysoxylum parasiticum* (Osb.) Kosterm. Inflorescence, detail. Papua New Guinea, Morobe Prov. (*Hoogland 8902*). Photograph R.D. Hoogland, 1964.

Habitat & Ecology — Rain forest including that on limestone, to 2100 m altitude. Pollinated by butterflies (Docters van Leeuwen in sched.).

Vernacular names — Sumatra: kulut (Mal.); Java: kraminan, langsep alas, langsep re, langsep were, lolohan, tjempagan, welahan, were, (Jav.), kokossan leuweung, mangir, maranginan, pingku, tanglar (Sund.), kapotrèn (Mad.); Philippines: bagolan, bagulan (S.L. Bis.), kabo-kábo (Ibn.), lambayan (Bag.), malaságing (Tag.); Sumbawa: bua pue; Timor: keloh nasa; Moluccas: kikiri (Tob.), pohun (Ternate); New Guinea: amsar (Biak), dogum (Onjob), gefalo (Kutubu), kanan (Amele), kamunsee (Tehid), kobong (Muju), kokuma (Minufia), nasurume (New Britain), tem (Mandobo), tora (Orokaiva).

Uses — The timber has a limited use in construction. The bark contains dysoxylum acid.

Note — Included here are plants formerly listed under a wide variety of names. The most widespread form is that corresponding to Osbeck's lowland collection in Java and has flowers on the trunk, even to ground level, the branches and twigs and even in the axils of the leaves. The flowers are borne on racemes of varying lengths, though usually rachis, pedicels and calyces are ± pubescent, sometimes markedly so. Thus included are the types (or where they are lost the descriptions) of (in order of publication) *Epicharis speciosa* (Timor), *Dysoxylum caulostachyum* (New Guinea), *D. schiffneri* (Queensland), *D. novoguineense* (New Guinea, the type lost but reduced to *D. caulostachyum* by Harms who probably saw it and with whom, from the description alone, I agree), *D. megalanthum* (Solomon Islands), *D. longicalicinum* and *D. roemeri* (New Guinea), *D. rumphii* (Moluccas), *D. densevestitum* (Queensland), *D. brachypodum* (S Sumatra), *D. fissum* (New Guinea), *D. callianthum* (Solomon Is.), *Epicharis hyacinthodora* (New Guinea).

At the extremities of the distribution, however, there are trees with predominantly ramiflorous inflorescences, which are very short, and with glabrous pedicels, which are very slender and long. Thus, on Lan Yü off Taiwan and in the Philippines are trees which match the types of *D. leytense* and *D. robinsonii*. Similar plants are known from N Sumatra, e.g. *de Wilde & de Wilde-Duyfjes 12290* (K, KEP, L, US, Z) and are approached by specimens from the Solomon Islands (e.g. *BSIP 5359*; K, L, LAE, SING). Furthermore, closely similar in these respects are the types of *Epicharis cauliflora* and *E. sericea* from Java, identical with which are a number of collections from that island, particularly its west and centre. As pointed out by Adelbert, l.c., who hesitated to amalgamate them with *D. parasiticum* (*D. caulostachyum*), they cannot be distinguished vegetatively, which is also true of most fruiting material. Unfortunately, most of the Javanese materials available to me have been sterile, but there is, amongst the flowering ones I have seen, an overwhelming preponderance of upland records for the *D. sericeum* form and, indeed, the types were collected from mountainous regions.

It is tempting to suggest that there is some altitudinal and geographical differentiation within this species and that it might be possible to recognize infraspecific taxa at the

subspecific level, but I believe that this would be premature pending more intensive fieldwork, particularly as the Philippine material like the type of *D. loheri* and the description of *D. longiflorum* are rather intermediate.

In the highlands of New Guinea are trees with very short axillary inflorescences and with ant-inhabited shoot apices, e.g. *Jacobs 9216* (L, LAE), which are identical with the type of *D. richardsonianum* but these are linked to mainstream *D. parasiticum* by the ramiflorous type of *D. longipetalum* from the Sogeri plateau. Again, some sheets of '*D. richardsonianum*' (e.g. *BW 13828*, BO, L, LAE) are treelets a few metres high when in flower. Other treelets in eastern New Guinea, e.g. *Mabberley 1764* (FHO, K, L) and *Conn et al. 54* (K), with flowers crowded at the ends of the racemes and with rather foliaceous bracts, look very different indeed from *D. parasiticum* of the lowlands but intermediate specimens, e.g. *Clemens 41337* (L) cloud the distinction.

Undoubtedly there is a very interesting story here but an herbarium study can get no further.

8. **Dysoxylum densiflorum** (Blume) Miq.

Dysoxylum densiflorum (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 9; C.DC. in DC., Monogr. Phan. 1 (1878) 499; King, J. As. Soc. Beng. 64, ii (1895) 46; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 41, incl. var. *minus* Koord. & Valeton ('*minor*'); Koord., Minah. (1898) 386; Backer, Schoolfl. Java (1911) 205; Koord., Exk. Fl. Java 2 (1912) 440; Ridley, Fl. Malay Penins. 1 (1922) 396; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 885; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 893; Backer & Bakh. f., Fl. Java 2 (1965) 122; Mabb. in Tree Fl. Malaya 4 (1989) 243; Zou, Acta Bot. Yunn. 11 (1989) 155. — *Epicharis densiflora* Blume, Bijdr. (1825) 167; G. Don, Gen. Syst. 1 (1831) 684; M. Roem. Synops. Monogr. 1 (1846) 102; Miq., Fl. Ind. Bat. 1, 2 (1859) 539. — *Guarea densiflora* (Blume) Spreng., Syst. Veg. 4, 2 (1827) 251. — *Alliaria densiflora* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Epicharis altissima Blume, l.c.; G. Don, l.c.; M. Roem., l.c.; Miq., l.c.

Hartighsea ramiflora Griff., Notul. 4 (1854) 501. — *Dysoxylum griffithii* Hiern in Hook. f., Fl. Brit. India 1 (1875) 549; C.DC. in DC., Monogr. Phan. 1 (1878) 497; King, J. As. Soc. Beng. 64, ii (1895) 46.

Dysoxylum trichostylum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 11, incl. f. *glabrum* Miq. ('*glabra*') & f. *pubescens* Miq.; C.DC., op.cit. (1878) 496. — *Alliaria trichostyla* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

[*Epicharis glabra* Blume ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 11, nom. in syn.]

Dysoxylum elmeri Merr., Univ. Calif. Publ. Bot. 15 (1929) 121.

Tree to 30(–45) m with clear bole to 13 m and 65 cm diam. Buttresses to 3.5 m tall, forming plankroots to 5 m long at base. Bark grey-green, smooth and lenticellate to fissured or flaking, the ± rectangular flakes leaving brown patches; inner bark thin, fibrous and pinkish, red mottled, creamy yellow within; sapwood straw. Leafy *twigs* 6–8 mm diam., grey-brown with prominent cicatrices and sometimes white latex. Apical buds with fist-shaped young leaves. *Leaves* to 1.5 m, in dense terminal spirals,

imparipinnate, 5–8-jugate; petiole 6–11 cm, terete to grooved adaxially proximally, swollen somewhat at base, ± finely pubescent; rachis 2–4 mm diam., terete, ± pubescent. *Leaflets* 14–20 by 5–8 cm, opposite to subopposite, shiny midgreen adaxially, paler abaxially, the apical one elliptic-ovate to -obovate, symmetrical, the laterals elliptic-ovate, the most proximal ovate and smallest, apices acuminate, bases obtuse to subcordate (to cuneate in apical leaflet), markedly asymmetric especially in most proximal leaflets, ± pubescent abaxially, sometimes conspicuously brown-pubescent, venation brochidodrome, costae c. 14 on each side, arcuate, drying paler adaxially, prominent and pubescent abaxially; petiolule 1–4(–6) mm (–12 mm in apical leaflet). *Racemes* or narrow thyrses to 10 cm long, solitary or fasciculate in axils or on twigs, sericeous; bracts c. 2 mm long, triangular, pubescent. *Flowers* sometimes in sessile cymules, hyacinth-scented. Pedicels 2–3 mm, pubescent. *Calyx* c. 2.5 mm long, campanulate, adpressed pubescent, deeply 4-lobed, lobes acute. *Petals* 4, c. 8–11 mm long, linear-oblong, acute, imbricate, sparsely hairy without, white. *Stami-*

Fig. 12. *Dysoxylum densiflorum* (Blume) Miq. Inflorescence. Bogor, Botanic Garden. Photograph M. Jacobs, November 1958.

Fig. 13. *Dysoxylum densiflorum* (Blume) Miq., fruiting branch, Ulu Gombak, Selangor, West Malaysia. Photograph D.J. Mabberley, July 1981.

nal tube subglabrous without, pilose within, conspicuously 8- (or 9-)striate, white, the margin 8-lobed, lobes subtruncate, emarginate or erose; anthers 8 (or 9), c. 1 mm long, oblong-ovate, alternating with lobes. *Disk* 3–4 mm tall, glabrous or sparsely hairy within, margin irregularly lobed. *Ovary* (3- or) 4-locular, adpressed pubescent; style adpressed pubescent; stylehead discoid, yellow. *Infructescence* to 10 cm or fruits solitary, rachis to 9 mm diam. *Capsule* to 4 cm long, 2 cm diam., pyriform to fusiform, (3- or) 4-valved, silky grey-green hairy; pericarp soft, with white latex. *Seeds* 2–4, testa black, partially enveloped in a white hilar (?) aril; the cotyledons green. — **Fig. 12, 13.**

Distribution — Southern Burma, Yunnan (Zou, l.c.), Thailand; *Malesia:* Sumatra, Malay Peninsula, Borneo, Java, Celebes, Lesser Sunda Islands (Bali, Lombok, Flores).

Habitat — Rain forest, to 1700 m altitude.

Vernacular names — Java: kedujo (C Java), kapinango, maranginan, pingku (Sund.), kraminan, tjempaga, tjempogo, tjepaga (Mad.); garu (Lombok, Flores); menkuang (Kuching); jolurut (Brunei).

Uses — According to Burkill (l.c.), the timber is useful.

9. Dysoxylum pettigrewianum F.M. Bailey

Dysoxylum pettigrewianum F.M. Bailey, Queensl. Dept. Agr. Bot. Bull. 5 (1892) 9 ('*Dysoxylon*'); Queensl. Fl. 1 (1899) 280; Comprch. Catal. Queensl. Pl. (1913) 88 ('*Dysoxylon*'); Lane-Poole, For. Res. Terr. Pap. New Guinea (1925) 101; C.T. White, Contr. Arnold Arbor. 4 (1933) 53.
Dysoxylum whiteanum Merr. & L.M. Perry, J. Arnold Arbor. 22 (1941) 256.
Dysoxylum brevipaniculum auct. non C.DC.: Harms, Bot. Jahrb. 72 (1942) 192, quoad spec. cit.
?*Dysoxylum cauliflorum* auct. non Hiern: Whitmore, Guide For. Br. Sol. Is. (1966) 84.
Dysoxylum cf. *macrothyrsum* sensu Beehler, Auk 100 (1983) 5, f. J.

Tree to 35 m and bole diam. 1.2 m; buttresses to 2.5 m tall and 2 m out. Bark brown, smooth with conspicuous pustular lenticels to finely vertically cracked or flaking; underbark pink; sapwood pale straw; heartwood pinkish brown, hard. *Twigs* grey, lenticellate, angled, cicatrose, leafy ones c. 6–8 mm diam. Apical buds with fist-shaped young leaves, ± pubescent. *Leaves* to 80 cm, usually less, imparipinnate, 3–6-jugate, paler abaxially; petiole 6–10 cm, flattened and (in sicco) sometimes grooved adaxially, lenticellate, ± finely shortly pubescent, base swollen; rachis 2–3 mm diam., terete to grooved adaxially (in sicco), ± finely pubescent. *Leaflets* opposite to subopposite, glabrous or sparsely sericeous abaxially, the terminal the largest, to 20 by 5.5 cm, oblong, base obtuse to subcuneate, apex acute to abruptly acuminate, the laterals smaller the more proximal, where elliptic-ovate, bases asymmetric, obtuse, apices acute, venation brochidodrome, costae c. 12 on each side, oblique, prominulous abaxially, petiolule 4–10 mm (–15 mm on apical leaflet), swollen. *Racemes* up to 19 cm long, usually less, axillary when solitary or in fascicles of up to 4 or on twigs and young branches, very finely adpressed pubescent; bracts 1–1.5 mm, triangular, adpressed pubescent. *Flowers* sessile, sweetly scented [honey, vanilla, *Dianthus barbatus* (Mabberley)]. *Calyx* 2.5–4 mm long, cupular, rather irregularly 4-dentate, densely adpressed pubescent outside, teeth acute, ciliate. *Petals* 4, 8–9 mm long, linear-spatulate, acute, imbricate at least at apices, glabrous or adpressed puberulent at apices. *Staminal tube* glabrous with 8 emarginate to bifid lobes; anthers 8, c. 1 mm long, oblong, subsessile, alternating with lobes, brown. *Disk* c. 3 mm long, cylindrical, long-hairy, margin erose to irregularly lobed. *Ovary* pubescent, 4-locular; style adpressed pubescent; stylehead discoid to subcapitate. *Infructescences* to 10 cm long, or fruits solitary or paired. *Fruits* to 8 by 4 cm, conspicuously brown-lenticellate, glabrous, orange-brown, subspherical, stipitate and with milky latex when young then asymmetric if with aborted seeds, conspicuously 4-angled and conical at both ends when mature with white latex in pericarp. *Seeds* 1–4, 23 by 14 mm, ellipsoid with orange sarcotesta.

Distribution — *Malesia:* Moluccas (Bacan, Halmahera, Aru Is.), New Guinea, New Britain; Solomon Islands, Australia (Queensland).

Habitat — Rain forest, including freshwater tidal forest, to 1370 m altitude.

Ecology — Fruits taken by birds of paradise (Beehler, l.c.).

Vernacular names — Aoufoufa (Mekeo), asselapa (Orokaiva), bobie, bok, wabwee, yehr (Kebar), enètawé (Oeta), ganan (Bilia), kamso, kamunem, kamunso (Mooi), kanan (Amele), lamel (Dumpu), seraka (Moini), totoberin (Onjob).

Uses — In Australia, the wood is used in cabinet work.

Notes — 1. This common tree, the scrub ironbark or Cairns satinwood of Australia, is closely related to *Dysoxylum brevipaniculum* though that is a small tree with very short inflorescences. The fruit and habit serve to distinguish it from *D. cumingianum*, its vicariant.

2. Very closely allied to *Dysoxylum pettigrewianum* or, possibly, a robust pubescent form of it are a number of gatherings from lowland New Guinea. The specimens of *D. pettigrewianum* with large leaflets are very similar but lack the heavy pubescence on the adaxial surface of the veins and the abaxial leaflet surfaces. However, flowers are unknown to me. The form has been collected from a number of localities in both NW and NE New Guinea.

10. **Dysoxylum cumingianum** C.DC.

Dysoxylum cumingianum C.DC. in DC., Monogr. Phan. 1 (1878) 497; Vidal, Phan. Cuming. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 81; Merr., Philipp. J. Sc. 1, Suppl. (1906) 72; Enum. Philipp. Flow. Pl. 2 (1923) 362; Briq., Mém. Inst. Nat. Genev. 24 (1935) 48; Kaneh., Form. Trees, rev. ed. (1936) 326, t. 282; Li, Woody Fl. Taiwan (1963) 397, t. 146; Fl. Taiwan 3 (1977) 547, t. 721; Chang, Quart. J. Chin. For. 11 (1978) 73. — *Epicharis cumingiana* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 341.

Hartighsea cauliflora Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 412. — *Alliaria cauliflora* (Turcz.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum cauliflorum auct. non Hiern (1875): Perkins, Fragm. Fl. Philipp. (1904) 31.

Dysoxylum triangulare Merr., Philipp. J. Sc., Bot. 3 (1908) 148; Enum. Philipp. Flow. Pl. 2 (1923) 365. — *Epicharis triangularis* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168.

Dysoxylum pyriforme Merr., Philipp. J. Sc., Bot. 3 (1908) 149; Enum. Philipp. Flow. Pl. 2 (1923) 365. — *Epicharis pyriformis* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168.

Dysoxylum testaceum Elmer, Leafl. Philipp. Bot. 8 (1919) 3093; ibid. 9 (1937) 3382.

Dysoxylum siargaoense Merr., Philipp. J. Sc. 17 (1921) 269; Enum. Philipp. Flow. Pl. 2 (1923) 365. — *Epicharis siargaoensis* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168.

[*Dysoxylum sulphureum* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 362, nom. in syn.; Elmer, Leafl. Philipp. Bot. (1937) 3380, descr. angl.]

[*Dysoxylum agusanense* Elmer, op.cit. (1937) 3350, descr. angl.]

Tree 5–25 m; bole to 28 cm diam., sometimes fluted and buttressed, buttresses to 50 cm out, 3 cm thick. Bark straw-coloured to dull brown, pustular; inner bark and sapwood yellowish; heartwood red. *Twigs* suberect, lenticellate, cicatrose, the leafy ones 5–8 mm diam. Young twigs and innovations hirtellous to fulvous pubescent (in sicco). Apical buds with fist-shaped young leaves. *Leaves* 30–70 cm, imparipinnate, 4–6-jugate, drying yellowish; petiole 5–10(–18) cm, 3–4 mm diam., flattened or grooved adaxially, ± densely pubescent, base swollen; rachis 2–3 mm diam., terete to grooved adaxially (in sicco), pubescent. *Leaflets* opposite to subopposite, membraneous, glabrous adaxially, ± densely pubescent abaxially, the terminal the largest, 18(–22) by

7(–11) cm, oblong to obovate, base obtuse to subcuneate, apex gradually cuspidate to acuminate, the laterals smaller the more proximal, where ovate, bases asymmetric, obtuse, apices acute, venation brochidodrome, conspicuously reticulate, costae c. 12–14 on each side, arcuate, prominent abaxially, petiolule 3–6(–9) mm (–15 mm on apical leaflet), flattened adaxially. *Racemes* to 10 cm, usually less, axillary or borne in axils of unexpanded leaves of lateral shoots, on twigs or branches, densely yellow-hairy (in sicco); bracts 1–1.5 mm, triangular, squarrose, densely pubescent; pedicels 1–1.5 mm, densely pubescent. *Flowers* white. *Calyx* c. 2.5 mm long, urceolate, rather irregularly 4-dentate, densely pubescent without, the teeth subacute. *Petals* 4, 8–10(–15) mm long, linear-oblong, acute, imbricate at least at apices, glabrous or sparsely hirtellous at apices. *Staminal tube* glabrous with 8 variously bilobed appendages; anthers 8, c. 1 mm long, oblong, subsessile, alternating with appendages. *Disk* 3–4 mm long, cylindrical, long-hairy, margin erose to irregularly lobed. *Ovary* pubescent, 4-locular; style hairy in proximal half; stylehead discoid, sometimes with distinct annulus. *Infructescences* to c. 5 cm long, usually less, or fruits solitary. *Fruits* to 3 cm long, ovoid to top-shaped, obscurely 4-angled, often conspicuously lenticellate, bright red-purple, carpels white within, dehiscing starwise. *Seeds* (3 or) 4, to 2 cm long, 8 mm wide, plano-convex, hanging by funicles from carpel walls, (?) aril whitish, testa black.

Distribution — Taiwan (Lan Yü); central *Malesia:* Philippines (Luzon, Mindanao, Mindoro, Panay, Polillo, Samar, Siargao), Celebes, Lesser Sunda Islands (Bali), Moluccas (Bacan, Halmahera).

Habitat — Rain forest, to 335 m altitude.

Vernacular names — Bitog (Lan.), igai (Mang.), malangi (Bil.), suha-suha (P. Bis.), tara tára (Tag.). Official common name in Philippines, tarublang (Bik), timatingan (Tag.).

Note — *Dysoxylum cumingianum* and *D. cauliflorum* are vicariant species and closely allied though the latter may be readily distinguished in the field by its cauliflorous inflorescences, while it differs also in the staminal tube and in the elenticellate fruit.

11. **Dysoxylum cauliflorum** Hiern

Dysoxylum cauliflorum Hiern in Hook. f., Fl. Brit. India 1 (1875) 549; C.DC. in DC., Monogr. Phan. 1 (1878) 498; Stapf, Trans. Linn. Soc. Bot. 4 (1894) 138, incl. var. *tomentellum* Stapf; King, J. As. Soc. Beng. 64, ii (1895) 45; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 161K; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320, incl. var. *tomentellum* Stapf; Ridley, Fl. Malay Penins. 1 (1922) 396, t. 40, incl. var. *elongatum* Ridley; Ridley, Dispersal (1930) frontisp.; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 885; Corner, Wayside Trees 1 (1940) 462, t. 153; ibid. 2 (1940) t. 136; Pellegr. in Fl. Indo-Chine, Suppl. (1946) 699; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 893; Corner, Seeds Dicots (1976) 189, t. 375, 384; Rubeli, Trop. Rain For. SE As. (1986) 76 cum tab.; Corner, Wayside Trees, ed. 3, 2 (1988) 501, t. 148; Polunin, Plants Flowers Singap. (1988) 118, t. 98; Mabb. in Tree Fl. Malaya 4 (1989) 242; Hô, Ill. Fl. Vietnam 2, 1 (1992) 490. — *Alliaria hiernii* Kuntze, Rev. Gen. Pl. 1 (1891) 109. — [*Epicharis hierniana* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168, t. 35K, nom. superfl.]

Dysoxylum cuneatum Hiern in Hook. f., Fl. Brit. India 1 (1875) 549, excl. fr. [= *Aphanamixis polystachya* (Wall.) R.N. Parker]; C.DC. in DC., Monogr. Phan. 1 (1878) 496, t. 7, f. 1. — *Alliaria cuneata* (Hiern) Kuntze, Rev. Gen. Pl. 1 (1891) 109, excl. fr. — *Epicharis cuneata* (Hiern) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168, excl. fr.

Dysoxylum beccarianum C.DC. in DC., Monogr. Phan. 1 (1878) 495; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320. — *Alliaria beccariana* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Lepisanthes forbesii Baker f., J. Bot. Lond. 62, Suppl. (1924) 25.

?*Dysoxylum angustifoliolum* Merr., Philipp. J. Sc. 26 (1925) 460.

[*Dysoxylum foxworthyi* Elmer, Leafl. Philipp. Bot. 9 (1937) 3363, descr. angl.]

Epicharis triangularis auct. non (Merr.) Harms: Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 478.

Trees 5–20(–30) m; clear bole to 16 m, 50 cm diam., sometimes fluted or with small buttresses to 60 cm tall, 5 cm wide, 30 cm out. Bark grey and smooth with lenticels and bosses of defunct inflorescences to mottled brown with rectangular flakes; inner bark fawn with sour smell and no conspicuous latex; wood straw-coloured. Leafy *twigs* 3–6 mm diam., lenticellate. Apical buds with fist-shaped young leaves, ± fulvous pubescent. *Leaves* to 60 cm, imparipinnate, 4- or 5- (to 6-)jugate; petiole 8–16 cm, 4–5 mm diam., terete to flattened or grooved adaxially when dry, ± rusty puberulous or even tomentose, swollen at base; rachis 3–4 mm diam., terete to flattened adaxially, ± rusty puberulent to pubescent or even tomentose. *Leaflets* to 17(–30) by 7 cm, the apical the largest, ovate-elliptic to ovate or obovate in the terminal one, opposite to subopposite, acuminate, base cuneate, or acute laterals often asymmetrically so, sparsely pubescent to densely rusty tomentose, particularly on abaxial surface of veins and adaxial surface of midrib, papery when dry, rather bullate when fresh, venation brochidodrome, conspicuously reticulate, costae c. 9–12 on each side, prominent abaxially, petiolules c. 4–9 mm (–15 mm on terminal leaflet), pubescent, somewhat swollen. *Spikes* to 8 cm, borne on persistent woody tubercles to 7 cm diam. on bole almost to ground level and major branches and sometimes axillary as well, usually in fascicles, tawny tomentose, sweetly scented (almonds and musk, Corner); bracts c. 1 mm long, triangular, adpressed pubescent; pedicels 2–3 mm, pubescent. *Calyx* 2–3 mm tall, cupular with 3 or 4 irregular shallow teeth, adpressed pubescent. *Petals* (3 or) 4, 7–10 mm long, linear-oblong, acute, imbricate at least at apices, glabrous or sparsely hairy without, white to pinkish or creamish. *Staminal tube* glabrous to puberulent without, sericeous within, white margin with (6–)8 bifid lobes; anthers (6–)8, at base of notches between lobes, c. 1 mm long, ovate. *Disk* 3–4 mm long, glabrous, margin irregularly lobed. *Ovary* (3-) 4- (or 5-)locular, pilose; style terete pilose in proximal half; stylehead ± discoid, yellow. *Fruits* solitary or clustered at end of rachides (to 8 cm long), to 4 cm long and 4 cm diam., top-shaped, 3- or 4- (or 5-)locular, sometimes 3–4-angled or weakly winged, glabrous, red, pericarp with milky latex, valves bright orange within. *Seeds* 1–4, to c. 2 cm long, 8 mm wide, plano-convex, borne on white placenta, aril basal, bright orange; testa black. — **Fig. 14**.

Distribution — Indochina (Vietnam, Cambodia, Thailand); *Malesia:* Sumatra, Bangka, Malay Peninsula, Borneo, Philippines (Palawan). Theobald [in Mason, Burma, ed. 3, 2 (1883) 582] also records this species for Burma.

Fig. 14. *Dysoxylum cauliflorum* Hiern. Stem base with infructescences. Sabah, Ulu Dusun (*Mabberley 1692*). Photograph D.J. Mabberley, May 1974.

Habitat & Ecology — Rain forest to 1500 m altitude, including ridge forest, freshwater swamp forest and heath forest. A common tree throughout the lowland forests particularly in Malaya and Sarawak, where it is the most conspicuous of all *Meliaceae* on account of its striking cauliflory. According to Corner, Wayside Trees 1 (1940) 462, "at certain times of the year, the Reservoir Jungle in Singapore is perfumed of an evening with the heavy fragrance of the flowers which develop simultaneously on all the trees."

Vernacular names — Banga, ngasakra, uchong chit (Iban); mensiah rima (Sum.).

Note — Forms with narrow leaflets, like those included in the protologue of *Dysoxylum angustifoliolum* of Palawan, are recorded from Malaya (e.g. *Kochummen KEP 76676*) and Sumatra (*Meijer 6800*) and especially tomentose forms are found in the Kinabalu region but also elsewhere.

12. **Dysoxylum brevipaniculum** C.DC.

Dysoxylum brevipaniculum C.DC., Nova Guinea, Bot. (1914) 1011; Harms, Bot. Jahrb. 22 (1942) 192.
Dysoxylum microstachyum Harms, op.cit. 196. (Syn. nov.).
?*Dysoxylum steinii* Harms, op.cit. 202.
?*Epicharis brachybotrys* Harms, op.cit. 203.

Tree 3–8 m. Bark dark brown, flaking longitudinally; inner bark dark brown; wood cream. *Twigs* cicatrose, the leafy ones 5–7 mm diam. Young twigs and buds ± fulvous strigose (in sicco). Apical buds with fist-shaped young leaves. *Leaves* 25–40 cm, imparipinnate, 2–5-jugate; petiole 4–7.5 cm, 2–3 mm diam., flattened to shallowly channelled adaxially (in sicco), ± densely strigose, base weakly swollen; rachis c. 2 mm diam., flattened adaxially (in sicco), glabrescent to strigose. *Leaflets* opposite to subopposite, pale abaxially, glabrous adaxially, finely sericeous to fawn strigose, particularly on veins abaxially, the terminal the largest, to 20 by 7 cm, oblong to obovate, base acute to subcuneate, apex acute to subacuminate, the laterals smaller the more proximal, when ovate, bases rounded to subacute, costae c. 9–12 on each side, arcuate, prominent abaxially, petiolule 0–3(–10) mm (–15 mm on apical leaflet). *Spikes* c. 3–6(–12) mm, axillary or on twigs, ± strigose; bracts c. 1 mm long, ovate, densely hairy. *Flowers* ± sessile. *Calyx* c. 2 mm long, cupulate, sometimes shortly pseudopedicellate, margin truncate to shallowly irregularly lobed, densely adpressed pubescent without. *Petals* 4, c. 7 mm long, narrowly spatulate, imbricate at apices, glabrous, white. *Staminal tube* glabrous, 8-ribbed with 8 emarginate to shallowly bifid lobes, white; anthers 8, c. 1 mm long, oblong, subsessile, on ribs alternating with lobes, included. *Disk* c. 2 mm long, margin crenate, glabrous except for a few long setae sometimes at margin. *Ovary* 3- or 4-locular, adpressed pubescent; style pubescent in proximal half, terete; stylehead discoid to subcapitate. *Capsules* solitary or in fascicles of up to 4, 4 cm long, c. 2 cm diam., obovoid to ellipsoid, stipitate, apiculate, subglabrous, conspicuously lenticellate, orange-red, dehiscing with 3 or 4 valves; pericarp with weak watery latex. *Seeds* 3 or 4, c. 2 cm long, plano-convex, red, (?arillate).

Distribution — *Malesia:* Central eastern New Guinea.

Habitat & Ecology — Rain forest on swampy flats and ridges including limestone, to c. 1230 m altitude.

Vernacular name — Basava (Waskuk).

Note — The fruiting specimen, *Hoogland 3706* from Northern Province, Papua New Guinea, seems referable here, though it is described as a 15 m high climber "once turned around a 25 cm thick tree." The climbing habit is not known elsewhere in the family.

13. **Dysoxylum mollissimum** Blume

Dysoxylum mollissimum Blume, Bijdr. (1825) 175; G. Don, Gen. Syst. 1 (1831) 683; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 18, incl. var. *sumatranum* Miq. & var. *halmaheirae* Miq.; C.DC. in DC., Monogr. Phan. 1 (1878) 512; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 80, incl. var. *sumatranum* Miq. & var. *teysmannii* (C.DC.) Koord. & Valeton; Backer, Schoolfl. Java (1911) 206; Koord., Exk. Fl. Java 2 (1912) 441; Atlas 1 (1913) t. 179; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 165; Backer & Bakh. f., Fl. Java 2 (1965) 123; Mabb. in Tree Fl. Malaya 4 (1989) 245; Zou, Acta Bot. Yunn. 11 (1989) 155; Taylor & Harden in Harden (ed.), Fl. N.S.W. 2 (1991) 281; Mabb., Blumea 38 (1994) 309. — *Trichilia mollissima* (Blume) Spreng., Syst. Nat. 4, 2 (1827) 252. — *Hartighsea mollissima* (Blume) A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 228; Miq., Fl. Ind. Bat. 1, 2 (1859) 538; Suppl. (1861) 504. — *Alliaria mollissima* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Trichilia alliacea Forst. f., Fl. Ins. Austral. Prodr. (1786) 33; DC., Prodr. 1 (1824) 623. — [*Hartighsea forsteri* A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 228, 265, nom. superfl. — *Macrocheton forsteri* M. Roem., Synops. Monogr. 1 (1846) 104 ('*Macrochiton*'), nom. superfl.] — *Dysoxylum alliaceum* (Forst. f.) Seem., Fl. Vit. (1865) 36, non *Dysoxylum alliaceum* (Blume) Blume. — *Dysoxylum forsteri* C.DC. in DC., Monogr. Phan. 1 (1878) 507; A.C. Smith, Contr. U.S. Nat. Herb. 30 (1952) 503. — *Alliaria alliacea* (Forst. f.) Kuntze, Rev. Gen. Pl. 1 (1891) 108. (Syn. nov.).

Guarea alliaria [Aiken, Trans. Soc. Arts Manuf. Comm. 48 (1831) 456, 480, nom. nud.] Buch.-Ham., Mem. Wern. Soc. 6 (1832) 305, excl. syn. Rumph. — *Hartighsea alliaria* (Buch.-Ham.) Arn. in Wight & Arn., Prodr. 1 (1834) 121 ('*Hartighesia*'); Steud., Nomencl., ed. 2 (1840) 722; M. Roem., Synops. Monogr. 1 (1846) 104. — *Dysoxylum hamiltonii* Hiern in Hook. f., Fl. Brit. India 1 (1875) 548; C.DC. in DC., Monogr. Phan. 1 (1878) 484; Briq., Mém. Inst. Nat. Genev. 24 (1935) 46, t. 3 f. 3; Kanj. et al., Fl. Assam 1, 2 (1936) 231; Anon., Wealth India 3 (1952) 120, nom. superfl. — *Dysoxylum alliaria* (Buch.-Ham.) Balakr., J. Bomb. Nat. Hist. Soc. 67 (1970) 57 ('*alliarum*').

Guarea paniculata auct. non Roxb. (1832): Wall., Cat. (1831/2), nom. nud.; Buch.-Ham., Mem. Wern. Soc. 6 (1832) 306. Cf. Mabb., Taxon 26 (1977) 528.

Turraea octandra Blanco, Fl. Filip. (1837) 349; ed. 2 (1845) 244; ed. 3, 3, 2 (1878) 89. — *Dysoxylum octandrum* (Blanco) Merr., Sp. Blanc. (1918) 209; Enum. Philipp. Flow. Pl. 2 (1923) 364; Elmer, Leafl. Philipp. Bot. 9 (1937) 3372. — [*Scyphostigma philippense* M. Roem., Synops. Monogr. 1 (1846) 94, nom. superfl.]

[*Epicharis mollis* Wall. ex Voigt, Hort. Suburb. Calc. (1845) 135, nom. nud. — *Guarea mollis* Wall. ex Hiern in Hook. f., Fl. Brit. India 1 (1875) 548, nom. in syn. — *Alliaria mollis* Kuntze, Rev. Gen. Pl. 1 (1891) 108, nom. nud.]

Didymocheton richii A. Gray, Bot. U.S. Expl. Exp. 1 (1854) 239, t. 20 ('*Didymochiton*'); C. Muell. in Walp., Ann. 4 (1857) 387. — *Dysoxylum richii* (A. Gray) C.DC. in DC., Monogr. Phan. 1 (1878) 511; Hemsl., J. Linn. Soc., Bot. 30 (1894) 171; Burkill, J. Linn. Soc., Bot. 35 (1901) 31; Yunck, Bull. B.P. Bishop Mus. 178 (1943) 71; A.C. Smith, Contr. U.S. Nat. Herb. 30 (1952) 502. — *Alliaria richii* (A. Gray) Kuntze, Rev. Gen. Pl. 1 (1891) 109. (Syn. nov.).

Dysoxylum samoense A. Gray, Bot. U.S. Expl. Exp. 1 (1854) 241 ('*Dysoxylon*'); C. Muell. in Walp., Ann. 4 (1857) 387; C.DC. in DC., Monogr. Phan. 1 (1878) 527; Setchell, Carn. Inst. Wash. Publ. 341 (1924) 80, t. 2; Christoph., Bull. B.P. Bishop Mus. 128 (1935) 115; A.C. Smith, Contr. U.S. Nat. Herb. 30 (1952) 504. — *Alliaria samoensis* (A. Gray) Kuntze, Rev. Gen. Pl. 1 (1891) 109. (Syn. nov.).

Hartighsea schizochitoides Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 412. — *Dysoxylum schizochitoides* (Turcz.) C.DC. in DC., Monogr. Phan. 1 (1878) 519 ('*schizochitoide*'), 763; Fern.-Vill. in Blanco, Fl. Filip., ed. 3 Nov. App. (1880) 42; Vidal, Phan. Cuming. (1885) 102; Rev. Pl. Vasc. Filip. (1886) 81. — *Alliaria schizochitoides* (Turcz.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum muelleri Benth., Fl. Austral. 1 (1863) 381; F. Muell., Fragm. Phyt. Austral. 5 (1865/6) 145; F.M. Bailey, Queensl. Fl. 1 (1899) 230; Compreh. Catal. Queensl. Pl. (1913) 86; Maiden, For. Fl. N.S.W. 3 (1907) t. 101; 4 (1909) t. 130; 4 pt. 40, t. 32; C.T. White, Contr. Arnold Arbor. 4 (1933) 53; Briq., Mém. Inst. Nat. Genev. 24 (1935) 50; Francis, Austral. Rainf. Trees (1951) 214, t. 124. — *Alliaria muelleri* (Benth.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dracontomelon pilosum Seem., Fl. Vit. (1865) 52, cf. A.C. Smith, Bull. B.P. Bishop Mus. (1936) 87; Brittonia 14 (1962) 238, f. 2.

Brucea quercifolia Seem., Fl. Vit. (1865) 33. — *Dysoxylum quercifolium* (Seem.) A.C. Smith, Brittonia 14 (1962) 245, f. 1; Fl. Vit. Nova 3 (1985) 556, t. 128C, D, 129A. (Syn. nov.).

Dysoxylum molle Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 18; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 301. — [*Alliaria zippeliana* Kuntze, Rev. Gen. Pl. 1 (1891) 109, nom. superfl.]

Dysoxylum teysmannii C.DC. in DC., Monogr. Phan. 1 (1878) 510. — *Alliaria teysmannii* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

[*Hartighsea trichosiphone* F. Muell. ex C.DC., op. cit. (1878) 508, nom. in syn.]

Dysoxylum velutinum Koord., Minah. (1898) 388, 636; Suppl. Fl. N.O. Cel. (1922) t. 44; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 895. (Syn. nov.).

Dysoxylum betchei C.DC., Bull. Herb. Boiss. II, 3 (1903) 178, quoad fol. (Syn. nov.).

?*Dysoxylum funkii* C.DC., Bull. Herb. Boiss. II, 6 (1906) 981. — ?*Didymocheton funkii* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 157.

Dysoxylum floribundum Merr., Philipp. J. Sc., Bot. 9 (1915) 450; Enum. Philipp. Flow. Pl. 2 (1923) 363; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 340, t. 259. (Syn. nov.).

Dysoxylum hainanense Merr., Lingn. Sc. J. 6 (1930) 280; How & Chen, Acta Phytotax. Sin. 4 (1955) 16, incl. var. *glaberrimum* How & Chen; Anon., Fl. Hainan. 3 (1974) 64, t. 567, incl. var. *glaberrimum*; Wu, Fl. Yunnan. 1 (1977) 250, incl. var. *glaberrimum*. — *Didymocheton hainanense* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 158.

[*Dysoxylum trukense* Kaneh., J. Dept. Agr. Kyushu Imp. Univ. 4 (1935) 345, nom. nud.]

Dysoxylum abo Hosakawa, J. Jap. Bot. 13 (1937) 277 cum tab. (Syn. nov.).

Dysoxylum leptorrhachis Harms, Bot. Jahrb. 72 (1942) 195. (Syn. nov.).

Dysoxylum pilosum A.C. Smith, Sargentia 1 (1942) 40; Contr. U.S. Nat. Herb. 30 (1952) 501.

Dysoxylum filicifolium Li, J. Arnold Arbor. 25 (1944) 301.

Tree to 34 m (–58 m teste Koorders & Valeton, l.c.) with clear bole to 25 m and 150 cm diam., fluted, buttresses to 2 m (–5 m, Koorders, 1913) tall, 1 m out, concave. Bark grey-brown with elongated brown lenticels, becoming pustular and cracking vertically or scaling; inner bark yellow-brown, flecked orange; sapwood pale brown, often with strong smell of garlic, onions, potatoes or turnips; heartwood hard, deep red. Crown rather irregular with terminal rosettes of leaves. *Twigs* ascending, cicatrose, brown or reddish, often conspicuously lenticellate; leafy twigs to c. 1 cm diam., ± lenticellate, glaucous to reddish, subglabrous to densely yellow pubescent. Apical buds with fist-shaped young leaves. *Leaves* 25–95 cm, imparipinnate, up to 14(–17)-jugate, the distal leaflets developing ± some time after the more proximal; petiole 5–10 cm, 3–4 mm diam., subglabrous to softly pubescent, often lenticellate, somewhat flattened adaxially or ± terete, base weakly swollen to clasping; rachis c. 3 mm diam., glabrescent to ± pubescent. *Leaflets* opposite to subopposite, c. 13–16 by 4–5 cm, the most proximal smaller, c. 6.5 by 3.5 cm, the apical often and the most distal laterals sometimes falling before developing, oblong to ovate, glabrous to sparsely pubescent, especially on veins

adaxially, subglabrous to densely soft pubescent abaxially, rarely with domatia, base symmetric to asymmetric, obtuse to subcordate distally, acute to cuneate proximally, apex apiculate to acute; costae c. 10–12 on each side, prominent abaxially, obtuse, mostly ± bifid 2/3 from midrib and anastomosing; petiolules 2–7 mm. *Thyrses* to 60 cm, axillary to supra-axillary, pendent, 1- or 2-branched, the primary to 12 cm, the more distal shorter, the secondary to c. 1 cm bearing sweetly scented multiflowered fascicles; bracts and bracteoles 2 or 3, c. 1 mm long, triangular, ± densely pubescent; pedicels 0–1 mm. *Calyx* c. 1 mm long, 1.5 mm diam., salveriform to shallowly cupular, ± densely adpressed pubescent, 4-lobed, the lobes irregularly triangular. *Petals* 4 (or 5), 8–12 mm long, linear, cream, ± sparsely pubescent without, ± imbricate at apices, adnate to staminal tube in proximal half. *Staminal tube* hairy on both sides, especially villous within, weakly ribbed, the margin subtruncate to 8-lobed, the lobes ± emarginate; anthers 8, c. 0.5 mm long, oblong, weakly locellate, glabrous, included. *Disk* 2–4 mm long, cylindrical, glabrous to pubescent, green, margin irregularly 4-toothed. *Ovary* ± sericeous 4-locular, each locule 1-ovulate; style terete, sericeous to villous in proximal half; stylehead subdiscoid to short-cylindrical. *Capsule* 15–25 mm diam., flattened globose, glabrous, 4-valved, red-brown, smooth or pustular-lenticellate; pericarp with white latex. *Seeds* 1–4, to 16 mm long, plano-convex, with red aril; cotyledons collateral, with white latex.

Distribution — Sikkim, Assam and southern China, throughout *Malesia* (apparently rare in Malay Peninsula) to Australia and the western Pacific. See the two subspecies below for further details.

Habitat & Ecology — Primary and secondary forests, to 1900 m altitude, including coastal forests behind mangrove. The fruits are eaten by parrots and monkeys though Womersley (*NGF 24964*) records that the seeds may germinate before the fruits are dispersed from the tree.

Vernacular names — Sumatra: bawang, rongga montji, sibusuk, surian puteh, tenggiling; Java: kibawang, kititingi (Sund.); Philippines: himamao, mata-matá (Tag.), malaaduas (Bik.), tibangar (Bag.); Celebes: sapang, tumbawa sela (Minah.); New Guinea: arak, ararak (Morobe), dzadza (Garaina), fiedja, metauw, niaa, sapinaan (Kebar), gilan (Daga), kamun (Mooi); New Britain: aumamia.

Uses — According to Harms (1940), this species is one of the biggest trees of Java but Backer & Bakhuizen f. (l.c.) record that it has not been collected in West Java since before the 1860s. Its wood has been used sporadically for houseposts and other construction and it is recorded as an important commercial lumber tree from which boards are made in Hainan. Subsp. *molle* is the red bean, kedgy-kedgy or pencil cedar of tropical Australia used in cabinet work. In Fiji, the fruits are used in the treatment of wounds; the constitution of the efficacious essential oil has been determined by Aalbersberg & Singh [Flav. & Frag. J. 6 (1991) 125].

Note — In its retarded leaf development and conspicuous though small bracteoles and the petals adnate to the tube, this species resembles *Dysoxylum gaudichaudianum*, but its 4-locular ovary with 1-ovulate locules are completely different as is the calyx. Moreover, the characteristic smell of the slash is similar to that of *Dysoxylum alliaceum* and its allies, with which it shares the same Sundanese name. Following Smith, I have

equated *Dysoxylum quercifolium* with *D. pilosum*. The first is based on a juvenile scrap from Fiji. It has lobed leaflets, a feature of some juvenile forms of *Dysoxylum variabile* and *D. bijugum* (Lab.) Seem. (New Hebrides, New Caledonia, Norfolk Island), though no more such have been seen from Fiji.

a. subsp. **mollissimum**

Dysoxylum mollissimum Blume excl. var. *halmaheirae* — *Guarea foetida* Blume — *Trichilia mollissima* (Blume) Spreng. — *Guarea alliaria* Buch.-Ham. — *Guarea paniculata* Buch.-Ham. — *Hartighsea mollissima* (Blume) A. Juss. — *Hartighsea alliaria* (Buch.-Ham.) Arn. — *Turraea octandra* Blanco — *Epicharis mollis* Wall. ex Voigt — *Scyphostigma philippense* M. Roem. — *Hartighsea schizochitoides* Turcz. — *Dysoxylum mollissimum* var. *sumatranum* Miq. — *Dysoxylum hamiltonii* Hiern — *Guarea mollis* Wall. ex Hiern — *Dysoxylum schizochitoides* (Turcz.) C.DC. — *Dysoxylum teysmannii* C.DC. — *Alliaria mollissima* (Blume) Kuntze — *Alliaria mollis* Kuntze — *Alliaria schizochitoides* (Turcz.) Kuntze — *Alliaria teysmannii* (C.DC.) Kuntze — *Dysoxylum mollissimum* var. *teysmannii* (C.DC.) Koord. & Valeton — *Dysoxylum floribundum* Merr. — *Dysoxylum octandrum* (Blanco) Merr. — *Dysoxylum hainanense* Merr. — *Didymocheton hainanense* (Merr.) Harms — *Dysoxylum filicifolium* Li — *Dysoxylum hainanense* var. *glaberrimum* How & Chen — *Dysoxylum alliaria* (Buch.-Ham.) Balakr.

Distribution — India (Assam), China (Yunnan, Hainan), Burma; *Malesia:* Sumatra, Malay Peninsula, Borneo (Sarawak: 1st Division; Sabah: Kinabalu area), Java (incl. Kangean Archipelago), Philippines (Luzon, Mindanao), Lesser Sunda Islands (Bali).

Note — In all the islands this conspicuous tree is found in subglabrous and pubescent forms, many of which were formerly given specific rank. The only consistent character which I have found useful in subdividing the hundreds of collections now available is that of the surface of the pericarp, which is, of course, only seen in fruiting material. Nevertheless, this has been found to be associated with geography in that, uncannily following Wallace's Line, plants to the west have smooth fruits, while those to the east have pustular lenticellate ones.

b. subsp. **molle** (Miq.) Mabb.

Dysoxylum mollissimum Blume subsp. *molle* (Miq.) Mabb., Blumea 38 (1994) 309. — *Trichilia alliacea* Forst. f. — *Hartighsea forsteri* A. Juss. — *Macrocheton forsteri* M. Roem. — *Didymocheton richii* A. Gray — *Dysoxylum samoense* A. Gray — *Dysoxylum muelleri* Benth. — *Dysoxylum alliaceum* (Forst. f.) Seem. non (Blume) Blume — *Dracontomelon pilosum* Seem. — *Brucea quercifolia* Seem. — *Dysoxylum molle* Miq. — *Dysoxylum mollissimum* var. *halmaheirae* Miq. — *Dysoxylum forsteri* C.DC. — *Dysoxylum richii* (A. Gray) C.DC. — *Hartighsea trichosiphone* F. Muell. ex C.DC. — *Alliaria alliacea* (Forst. f.) Kuntze — *Alliaria muelleri* (Benth.) Kuntze — *Alliaria richii* (A. Gray) Kuntze — *Alliaria samoensis* (A. Gray) Kuntze — *Alliaria zippeliana* Kuntze — *Dysoxylum velutinum* Koord. — *Dysoxylum funkii* C.DC. — *Dysoxylum trukense* Kaneh. — *Dysoxylum abo* Hosakawa — *Didymocheton funkii* (C.DC.) Harms — *Dysoxylum pilosum* A.C. Smith — *Dysoxylum betchei* C.DC., p.p. — *Dysoxylum quercifolium* (Seem.) A.C. Smith.

Differs from the type merely in its pustular-lenticellate fruit.

Distribution — Australia (Queensland, N New South Wales), Carolines (Truk), the Solomon Islands, New Hebrides, Fiji, Samoa, Niue; *Malesia:* Celebes, Lesser Sunda Islands (Flores, Timor, Wetar), Moluccas (Halmahera, Bacan, Buru, Ceram, Sula Islands), New Guinea, Bismarck Archipelago.

14. Dysoxylum annae Mabb.

Dysoxylum annae Mabb., Blumea 38 (1994) 303, f. 1.

Tree to 28 m and bole to 50 cm diam., buttressed. Leafy *twigs* 5–7 mm diam., somewhat striate; buds with fist-shaped young leaves, sericeous. *Leaves* 20–40 cm, 5–7-jugate with terminal scar, stump or very narrow leaflet to 2.5 cm long, glabrous to finely puberulent, drying yellowish; petiole 10–14 cm, angled, grooved adaxially, weakly swollen basally. *Leaflets* 9–15 by 3.5–5.5 cm, narrowly oblong to subfalcate, opposite to subopposite, bases ± markedly asymmetric, obtuse distally, acute proximally, apices acuminate, costae c. 14 on each side, obtuse, conspicuously forked c. 1/3 from margin, prominulous on both surfaces in sicco, secondary veins almost as conspicuous; petiolules c. 3 mm. *Thyrse* 10–35 cm, narrowly pyramidal, axillary to supra-axillary; axes glabrous or subglabrous; basal branches to 5 cm long, squarrose, bearing secondary branches to 1.5 cm with 1–3-flowered cymules; bracts and bracteoles 0.5 mm, lanceolate; pedicels c. 1 mm. *Calyx* c. 1.5 mm long, c. 2 mm diam., 4-lobed to about half way, adpressed pubescent, margin ciliate, continuous with pseudopedicel 1–2 mm. *Petals* 4, c. 4.5 mm long, yellowish, narrowly oblong, valvate, adnate to staminal tube in proximal half. *Staminal tube* glabrous or sparsely hairy without, margin 8-lobed, the lobes irregularly laciniate; anthers 8, c. 0.5 mm long, ovate, glabrous, inserted between lobes and at apices of conspicuous ribs (vascular bundles). *Disk* c. 1.5–2 mm, pubescent, margin irregularly lobed. *Ovary* densely hairy, 4-locular, each locule 1-ovulate; style terete, sericeous in proximal 3/4; stylehead shortly subdiscoid. *Infructescence* branched. *Capsule* c. 2.5 cm diam., subglobose to top-shaped, glabrous, pale yellow, 4-valved. *Seeds* 4, c. 1 cm long, plano-convex, with red (?) aril.

Distribution — *Malesia:* New Guinea (northwest).

Habitat — Rain forest, to 30 m altitude.

Vernacular name — Seraka puteh (Manikiong).

Notes — 1. This is closely related to *Dysoxylum mollissimum* Blume but differs in its smaller leaves with fewer leaflets, of which the terminal is scarcely developed, its small flowers, and less hairy tube.

2. Possibly related to this but collected at 3000 m in the Wichmann Mts of southwest New Guinea is a juvenile form with paripinnate and imparipinnate leaflets, which are deeply lobed like those of some forms of *Dysoxylum mollissimum*, *D. variabile* and *D. bijugum* (Lab.) Seem. from New Hebrides, New Caledonia and Norfolk Is. It has been collected once (*von Römer 1333*, in BO).

15. Dysoxylum variabile Harms

Dysoxylum variabile Harms in K. Schum. & Laut., Nachtr. Fl. Deutsch. Schutzgeb. Südsee (1905) 282.
Dysoxylum nymanianum Harms, l.c.
Chisocheton sogerensis Baker f., J. Bot. Lond. 61, Suppl. (1923) 8.

Tree to 10(–15) m, flowering when 3 m tall or less; bole to 20(–30) cm diam., often of poor form. Bark grey-brown, smooth, lenticellate, to finely cracking; inner bark creamish; sapwood cream; heartwood pinkish. Leafy *twigs* 4–6 mm diam., lenticellate,

subglabrous to densely fulvous pubescent. Apical buds with fist-shaped young leaves. *Leaves* 12–30 cm, paripinnate with caducous apical spike to 2 mm long or, in juveniles, imparipinnate, (5–)10–14(–16)-jugate, the distal leaflets sometimes developing ± some time after the most proximal pseudostipular; petiole 0–3 cm, 2–3 mm diam., subglabrous to bristly pubescent, ± terete, base weakly swollen; rachis 2–3 mm diam., glabrescent to bristly pubescent. *Leaflets* opposite to subopposite, the subdistal the largest 7–12 by 1.8–3 cm, narrowly oblong, the more proximal the smaller, the pseudostipules c. 8 by 6 mm, suborbicular, glabrescent with a few hairs on midrib adaxially and on nerves and midrib abaxially, to finely pubescent adaxially and densely fulvous pubescent abaxially, margin entire to shallowly lobed, deeply so in juveniles, where lobes reach midrib, base rounded to obtuse or acute, asymmetric, apex acute to acuminate; costae c. 20–22 on each side, arising at right angles to midrib, ± forked and looped at margin, usually with conspicuous domatia in their axils, some intercostals almost as prominent as nerves; petiolules 0–1 mm. *Thyrses* 0.5–5 cm long, axillary, 1- or 2-branched, the primary to 2 cm, the secondary to 1 cm, bearing fascicles of 1–3 sweetly scented flowers, axes ± densely strigose; bracts and bracteoles c. 1 mm long, narrowly triangular, yellow strigose; pedicels c. 2 mm, articulated with swollen pseudopedicels, 1–2 mm long. *Calyx* continuous with pseudopedicel, c. 1–5 mm diam., shallowly cupular, lobes 4 (5), 0.5–1 mm, ± acute, densely strigose. *Petals* (3) 4, c. 9 mm long, c. 1.5–2 mm wide, narrowly oblong, creamish white, valvate, pilose without especially at apices, adnate to staminal tube in proximal 1/3. *Staminal tube* glabrescent to somewhat pilose without, weakly ribbed, margin ± irregularly lobed to praemorse; anthers (6) 8, c. 1 mm long, narrowly oblong, glabrous, included, their tips some 1 mm within tube. *Disk* c. 3 mm long, cylindrical, glabrous, margin crenate to irregularly 8-lobed. *Ovary* densely adpressed golden pubescent, 3- or 4-locular, each locule 1-ovulate; style terete, adpressed pubescent in proximal 2/3, stylehead suborbicular to short-cylindrical. *Capsule* c. 2 cm diam., subglabrous, apiculate, whitish with ± dense golden tomentum, 3- or 4-valved; pericarp white within, with white latex when cut. *Seeds* 3 or 4, c. 15 mm long, plano-convex, with red (?) aril and white hilum, apparently dangling from funicles at capsule dehiscence.

Distribution — Solomon Islands and *Malesia:* New Guinea and Bismarck Archipelago.

Habitat & Ecology — Ridge, hill, submontane forests including secondary forest and those on limestone, occasionally riparian, to 2100 m altitude.

Vernacular names — Amsusu (Jal), angas (Waskuk), arasapa (Maibrat), igiligil (Sempi), keke (Garumaia), naióya (Naho), narualavia (New Britain), niungwawi (Ambakanja), palya (Enga), pimakumbuat (Maring).

Uses — In the Sepik, the bark is reported to be cooked with sago and eaten as a treatment for sores (*Hoogland & Craven 10124*).

Note — Synonymy established by Stevens, Contr. Herb. Austral. 11 (1975) 53.

16. **Dysoxylum papuanum** (Merr. & L.M. Perry) Mabb.

Dysoxylum papuanum (Merr. & L.M. Perry) Mabb., Blumea 31 (1985) 131. — *Pseudocarapa papuana* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 315. — *Aglaia papuana* (Merr. & L.M. Perry) Harms, Bot. Jahrb. 72 (1942) 161.

Aglaia sapindina auct. non (F. Muell.) Harms: Lane-Poole, For. Res. Papua & New Guinea (1925) 100; White & Francis, Proc. Roy. Soc. Queensl. 38 (1927) 237.
Dysoxylum micranthum Merr. & L.M. Perry, J. Arnold Arbor. 22 (1941) 257.

Tree 10–40(–45) m; bole to 90(–130) cm diam., often with buttresses to 3 m tall, 3 m out and 12 cm thick. Bark grey-brown smooth with corky lenticels in vertical rows, becoming fissured longitudinally and eventually flaking; inner bark straw mottled darker, darkening on exposure, frequently with acrid turnip smell, sapwood white to pinkish; heartwood red. Leafy *twigs* 6–9 mm diam., lenticellate, subglabrous to fulvescent tomentose; apical bud densely sericeous, the young leaves fist-shaped. *Leaves* 25–40 cm, paripinnate, 4–6-jugate, distinctly pale abaxially; petiole 3–6 cm, terete, swollen at base, glabrous to softly brown pilose. *Leaflets* 9–14.5 by 2.5–5.5 cm (subapical, the most proximal smaller), narrowly oblong to elliptic, glabrous or scattered hairy adaxially and brown pilose, particularly on veins abaxially, bases acute to cuneate, often markedly asymmetric, apices ± acuminate, costae 7–10 on each side, subsquarrose, weakly arcuate, ± bifid 2/3 from midrib and looped at margin; petiolules 1–4 mm, swollen. *Thyrses* axillary or borne on axillary dwarf shoots with no leaves and sericeous terminal buds, sometimes in axils of fallen leaves, 4–13 cm, ± squarrose, often branched from base; axes subglabrous to brownish pilose; bracts and bracteoles c. 1 mm long, triangular, caducous; branches 3–5 cm bearing fascicles of weakly scented flowers or branchlets bearing them; pedicels 1–2 mm, articulated with pseudopedicels c. 2 mm, both swollen near articulation. *Calyx* 0.5–0.8 mm long, campanulate, subglabrous to adpressed pubescent, margin 4- (or 5-)lobed, ± ciliate. *Petals* 4 (or 5), 1.5–2 mm long, broadly ovate, acute, white or cream, fleshy, glabrous without, ± pubescent within, valvate, adnate to staminal tube at base. *Staminal tube* cylindrical, glabrous to pubescent, very thin at base, margin 8(–10)-dentate or -lobed; anthers 8(–10), c. 0.8 mm long, included or slightly exserted opposite lobes, emarginate, ± hairy. *Disk* c. 0.5 mm tall, deeply crenate or 8-lobed. *Ovary* pilose, 2- or 3-locular; style ± glabrous; stylehead flattened capitate. *Capsule* c. 2.5 cm diam., flattened globose, glabrous, white, drying 3-angled, pericarp with white sap (Womersley). *Seeds* c. 15 mm long, ellipsoid, covered with red (?) aril.

Distribution — Australia (N Queensland), Solomon Islands and *Malesia:* New Guinea.

Habitat — Primary and secondary forests to 1100 m altitude.

Vernacular names — Fiedjaa, njia (Kebar), geseikerie, melawak (Mooi), kanan (Amele), kisingas (Bilia), mongu (Faita), nagimrere, natelemon (New Britain), pasip (Dumpu).

Uses — Timber used for house-building (Morobe Prov., Papua New Guinea).

Note — At first sight, the complicated inflorescences of minute flowers, the smallest in the genus, recall *Aglaia*, but the paripinnate leaves distinguish it at once, while details of the flower show similarities with *Anthocarapa*, to which it is undoubtedly allied.

17. **Dysoxylum yunzaingense** Merr. & L.M. Perry

Dysoxylum yunzaingense Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 303.

Tree 4.5–7 m tall. Leafy *twigs* 3–7 mm diam., lenticellate, subglabrous. Apical buds sericeous, young leaves fist-shaped. *Leaves* 14–22 cm long, paripinnate, 3- or 4-jugate with caducous spike 2 mm long, petiole 4–7 cm, glabrous, ± grooved adaxially, swollen basally; rachis subglabrous. *Leaflets* opposite to subopposite, the most distal largest, 9–13 by 3.5–5 cm, the more proximal smaller, oblong to subfalcate, subcoriaceous, subglabrous, base asymmetric, attenuate, apices acuminate, the acumen to 8 mm long, rounded, costae c. 11–14 on each side, subsquarrose and weakly arcuate, ± bifid 2/3 from midrib and anastomosing; petiolules c. 5–6 mm, hirtellous. *Thyrses* fasciculate (arising from a dwarf shoot with sericeous apical bud) or solitary, axillary or in axils of fallen leaves, 4–9 cm long, often branched from base; axes subglabrous to minutely pubescent; branches to c. 5 cm or absent, bearing cymose fascicles of scented flowers; bracts and bracteoles c. 1 mm, lanceolate, pedicels 2–4 mm, articulated with pseudopedicels, 2–4 mm, both swollen at articulation. *Calyx* c. 1 mm deep, salveriform to subcampanulate, shallowly 4-lobed, margin ciliate. *Petals* 4, c. 4 mm long, glabrous, creamy white, adnate to staminal tube in proximal 1/3. *Staminal tube* pubescent without, pilose distally within, margin undulate to ± irregularly lobed; anthers 8–10, c. 0.5 mm long, included, apiculate. *Disk* 1–2 mm tall, fleshy, glabrous except pilose within at base, margin undulate. *Ovary* (?) 4-merous, adpressed pubescent; style adpressed pubescent in proximal half; stylehead subdiscoid with annulus. Immature *fruit* 6 mm diam., glabrous, only known.

Distribution — *Malesia:* eastern New Guinea. Collected rarely.

Habitat — Highland forest, 1250–1500 m altitude.

Note — Dried material is separated with difficulty from that of *Dysoxylum papuanum* (q.v.) from the same island. It has larger flowers however.

18. **Dysoxylum inopinatum** (Harms) Mabb.

Dysoxylum inopinatum (Harms) Mabb., Blumea 31 (1985) 131. — *Pseudocarapa inopinata* Harms, Bot. Jahrb. 72 (1942) 160.

Tree to 30 m; bole to 90 cm diam. Bark fissured to conspicuously scaling and peeling upwards, dark brown; inner bark creamy with white latex; sapwood reddish; heartwood red, hard. Leafy *twigs* c. 5 mm diam., glabrous to subglabrous, innovations adpressed pubescent. Apical buds with narrowly fist-shaped sericeous young leaves, pale in sicco. *Leaves* c. 15–25 cm long, paripinnate with terminal caducous spike, pale in sicco, (2–) 3–4(–6)-jugate; petiole c. 5–9 cm long, c. 2.5 mm diam., deeply grooved adaxially, ± glabrous. *Leaflets* 4–12 by 2.5–5.5 cm, (narrowly) oblong to oblong-ovate, ± glabrous, base narrowly oblique to very asymmetric, apex acuminate, costae c. 11 on each side, obscurely looped near margin, rest of venation obscure; petiolule 4–10 mm. *Thyrse* to 9 cm, each branch few(–1)-flowered, ± puberulous, weakly supra-axillary; flowers fragrant; bracts c. 1 mm long, deltoid, ± pubescent, pedicels c. 5–6 mm, very slender, articulated with attenuate pseudopedicels c. 7–9 mm; bracteoles minute. *Calyx* c. 2–3 mm long, broadly cupuliform to salveriform, margin very shallowly lobed, lobes minutely acuminate, to crenulate, glabrous to puberulous or even ciliate at margin. *Petals*

(4 or) 5, 7–8 by 2.5–3 mm, broadly lanceolate, valvate to weakly imbricate, white, apices acute, rather thick, glabrous. *Staminal tube* urceolate to subcylindrical, (sub)glabrous, white; margin subcrenulate to truncate; anthers (9) 10, c. 0.7 mm long, ovate, subapiculate, almost included; pollen shed in tetrads. *Disk* c. 1.5 mm tall, subannular, thick, glabrous, margin weakly subcrenulate. *Ovary* (?4-) 5-locular, (sub)glabrous, each locule with 2 ± superposed ovules; style glabrous, stylehead subcapitate. *Capsule* c. 1.5 cm diam., (4-) 5-locular, globose, orange-red, each locule with 1 or 2 seeds. *Seed* c. 8 mm long, ovoid, with circumhilar aril.

Distribution — *Malesia:* northern and central New Guinea.

Habitat — Forests to 1500 m altitude, from just behind mangrove to mossy fagaceous forest, sometimes allegedly very common at low altitudes.

Vernacular names — Araboere (Biak), awawarata (Kweba), beor (Asmat), kasin (Tehid), kierbar (Tor), lessaa'i (Manikiong), wamtja (Kebar).

Note — In some respects, particularly the urceolate staminal tube, this tree approaches *Synoum* A. Juss., a genus restricted to Australia, but the leaves there are imparipinnate and the seeds are united by a common 'arillode'.

19. **Dysoxylum crassum** Mabb.

Dysoxylum crassum Mabb., Blumea 38 (1994) 305, f. 4.

Tree to 30 m; bole to 45 cm diam. Bark fawn to dark purplish brown, fissured to flaking; the inner bark pinkish. Leafy *twigs* c. 5–7 mm diam., striate, apical buds with ± fist-shaped pubescent young leaves. *Leaves* 16–30 cm, 3–5-jugate, with terminal spike or its stub; petiole 4–6 cm, deeply sulcate to winged, rather warty. *Leaflets* 9–14 by 3.5–6 cm, elliptic-oblong, coriaceous, glabrous, bases weakly asymmetric, cuneate, apices acute to subacuminate, midrib sunken adaxially, prominent abaxially, costae 6–9 on each side, very obscure; petiolules c. 5–9 mm, sulcate, blackish when dried. Lateral buds supra-axillary, pale, pubescent, conspicuous. *Thyrses* 2–4 cm, few-flowered, sweetly scented, supra-axillary or borne on lateral dwarf shoots; axes stout, woody, fawn pubescent; bracts c. 2 mm, triangular, pubescent; pedicels c. 3 mm, articulated with pseudopedicels. *Calyx* c. 4.5 mm long, 8 mm diam. with pseudopedicel c. 1 mm, ± pubescent without, margin irregularly 5-lobed. *Petals* 5, c. 15 by 6 mm, lanceolate, papillose, pale green to creamy white. *Staminal tube* glabrous, margin minutely c. 20-lobed, the lobes truncate; anthers 10, c. 1 mm long, ellipsoid, ± minutely hairy, weakly exserted, pollen shed in tetrads. *Disk* c. 1 mm tall, cushion-like, fleshy, glabrous. *Ovary* glabrous, 5-locular, each with 2 collateral ovules; style terete, glabrous stylehead depressed capitate, apically dimpled. *Capsule* at least 3 cm diam., globose, apically mamillate, weakly stipitate, 5-locular. *Seeds* unknown.

Distribution — *Malesia:* Borneo (C & N Sarawak).

Habitat — Dipterocarp and kerengas forest, 700–1150 m altitude.

Vernacular name — Birar para.

Note — Collected only five times.

20. **Dysoxylum dumosum** King

Dysoxylum dumosum King, J. As. Soc. Beng. 64, ii (1895) 39; Ridley, Fl. Malay Penins. 1 (1922) 391; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 132; Mabb. in Tree Fl. Malaya 4 (1989) 243.

Tree or treelet 2–6 m; bole c. 7 cm diam. Bark smooth to finely cracked, brown; inner bark brown; wood brown. Leafy *twigs* c. 2–3 mm diam. Apical buds with fist-shaped young leaves. *Leaves* to 18.5(–35.5) cm, paripinnate with apical spike to 5 mm, to 3(–5)-jugate, glabrous, subcoriaceous, dark green when fresh; petiole 2–10 cm, c. 2 mm diam. *Leaflets* opposite, 5–15.5 by 2–4.5(–6) cm, elliptic-oblong, bases cuneate, apices strongly acuminate, acumen to 7 mm, veins 5–7 on each side, often very inconspicuous, venation brochidodrome; petiolules c. 3–4 mm, slightly swollen, blackish when dried. *Thyrses* to 10 cm, axillary to supra-axillary, weakly branched, axes finely sericeous; branches to 2 cm with 1–3 flowers; bracts c. 1.5 mm, triangular, pubescent; pedicel 0–2 mm; pseudopedicel 3–5 mm, continuous with calyx. *Calyx* c. 1.5–2 mm diam., cupular, subglabrous, margin with 4 (5) teeth, ciliate. *Petals* (3) 4, c. 3.5–4 mm long, oblong, subglabrous, adnate to tube proximally, white apices obtuse, thickened. *Staminal tube* glabrous, margin with 8 ± emarginate short lobes; anthers (6) 8, c. 0.5 mm long, ovate, weakly exserted, alternating with lobes; pollen shed in tetrads. *Disk* c. 1 mm tall, fleshy, margin ± lobed. *Ovary* 4-locular, pilose; style cylindrical, sparsely pilose proximally; the stylehead discoid to subcylindrical. *Capsule* c. 1–2 cm diam., flattened-globose, glabrous, red. *Seeds* 3 or 4, dark brown, with circumhilar orange (?) aril.

Distribution — *Malesia:* Malay Peninsula (Trengganu, Perak, Pahang, Selangor, Johore), Riau-Lingga Archipelago.

21. **Dysoxylum sparsiflorum** Mabb.

Dysoxylum sparsiflorum Mabb., Blumea 38 (1994) 312, f. 6.

Tree 4–12 m. Leafy *twigs* c. 4–6 mm diam., lenticellate, sericeous to densely long-tomentose when young. Apical buds with fist-shaped young leaves, densely hairy. *Leaves* 20–40 cm, paripinnate with apical spike c. 2 mm long, densely hairy, 2- or 3-jugate; petiole 3.5–8 cm long, 1.5–3 mm diam., ± pubescent, swollen and flattened adaxially at base; rachis 6–11 cm, c. 2 mm diam., ± pubescent. *Leaflets* opposite to subopposite, the most apical the largest, 10–21 by 3–6 cm, the most proximal the smallest, 5–11 by 2–4.5 cm, narrow elliptic or oblong to obovate, glabrous except on the midrib on both surfaces, to densely long pubescent abaxially also, base weakly asymmetric, gradually cuneate, apex acuminate to subcaudate; costae c. 9–11 on each side, the secondaries almost as conspicuous, bifurcating c. 2/3 from the midrib and anastomosing; petiolules 1–3 mm, subgeniculate. *Inflorescence* a condensed fascicle of thyrses, axillary, c. 5 cm long; axes c. 3–8 mm, ± densely hairy, the branches and pedicels subglabrous; the branches with 1–5 pedicels; bracts and bracteoles c. 1 mm long, triangular, densely hairy, caducous; pedicels 5–15 mm, very slender, articulated with attenuate pseudopedicels 5–11 mm long. *Calyx* c. 2–4 mm, shallowly cupular,

glabrous, margin subtruncate to irregularly, shallowly 5-lobed. *Petals* 5, 18–20 mm long, narrowly oblong, white, glabrous, valvate, apices acute, fleshy. *Staminal tube* glabrous, margin crenate; anthers 10, c. 1 mm long, oblong, apiculate, glabrous, inserted c. 2 mm within tube. *Disk* c. 5 mm tall, narrowly cylindrical, the margin thickened, crenulate. *Ovary* and ovules unknown; style terete, densely pubescent in proximal 7/8; stylehead shortly cylindrical. *Capsule* c. 3 cm diam., spherical, glabrous. *Seeds* unknown.

Distribution — *Malesia:* New Guinea (Irian Jaya: SW part; Papua New Guinea: Sepik, Morobe, and Central Provinces).

Habitat — Lowland rain forest to 150 m altitude.

Vernacular names — Abongo, apangosavara, apungosavaraka (Waskuk), sefi, swagi, toba (Wagu).

Uses — Timber said to be used for housebuilding and as axe-handles (*Hoogland & Craven 10519*).

22. **Dysoxylum boridianum** Mabb.

Dysoxylum boridianum Mabb., Blumea 38 (1994) 305, f. 2.

Treelet 1–3 m tall. Bark grey-brown, pustular and fissured, inner bark brown; wood straw. Leafy *twigs* 2–3 mm diam., lenticellate, finely sericeous when young. Buds densely sericeous, young leaves fist-shaped. *Leaves* 8–22 cm long, paripinnate, 2–4-jugate, with terminal, caducous, densely sericeous subulate spike to 6 mm long; petiole 3.5–7 cm, ± flattened adaxially, glabrous to thinly sericeous, swollen at base. *Leaflets* opposite or subopposite, the subapical the largest, 8–10.5 by 2.5–3.5 cm, subcoriaceous, glabrous to thinly sericeous abaxially, ovate to oblong, bases asymmetric, acute to cuneate, apices acuminate, costae c. 12 on each side, the secondary ones almost as conspicuous, subsquarrose, weakly arcuate, forked c. 2/3 from midrib and looped, prominulous on both surfaces in sicco; petiolules c. 1–2 mm, swollen, drying blackish. *Inflorescences* 2.5–6 cm, borne on dwarf axillary (or in axils of fallen leaves) shoots with minute sericeous terminal buds, not or sparsely branched, in fascicles of 1–4, each bearing 1–3(–6) flowers; axes delicate, glabrous, c. 0.5 mm diam. in sicco, erect; bracteoles c. 1.5 mm long, narrowly triangular, finely sericeous; pedicels c. 5–9 mm, swollen at articulation with pseudopedicel. Pseudopedicel c. 8 mm, narrowly funnel-shaped, c. 1.5 mm diam. beneath calyx. *Calyx* c. 2.5 mm deep, 3.5 mm diam., salveriform, glabrous, irregularly 4-dentate to 1/3. *Petals* 5, c. 15 by 4 mm, narrowly oblong, glabrous, apex acute. *Staminal tube* c. 4 mm diam., glabrous, margin subtruncate; anthers 8, c. 1.5 mm long, narrowly oblong to boat-shaped, included. *Disk* c. 2 mm long, narrowed towards apex where fleshy and irregularly crenate. *Pistil* (male only known) terete, sparsely pubescent in proximal half; stylehead c. 1.5 mm diam., subcylindrical. *Capsule* c. 2.5 cm long, 1.5 cm diam., glabrous, lenticellate-pustular, pyriform, stipitate, stipe to 8 mm long, 3–4-locular, greenish white. *Seeds* 3 or 4, c. 1 cm long, trigonal, covered in orange (?) aril.

Distribution — *Malesia:* New Guinea. So far known only from the environs of Boridi village, Port Moresby District, Central Province, Papua New Guinea.

Habitat — Fagaceous forest at c. 1370 m altitude.

Notes — 1. This elegant treelet is the upland counterpart of the taller *Dysoxylum sparsiflorum* of the lowlands. The type specimen has an infructescence at the base of a long axillary shoot, which bears dwarf shoots of inflorescences in the axils of cicatrices, suggesting that the dwarf shoots may continue growth after fruiting as in *Melia azedarach* (q.v.) and continue to produce inflorescences at the base.

2. First collected by Carr at Boridi in Sept. 1935 and only seen in this locality since.

23. Dysoxylum pauciflorum Merr.

Dysoxylum pauciflorum Merr., Philipp. Govt. Lab. Bur. Bull. 35 (1906) 32; Enum. Philipp. Flow. Pl. 2 (1923) 365.
Dysoxylum biflorum Merr., Philipp. J. Sc., Bot. 5 (1910) 185; Enum. Philipp. Flow. Pl. 2 (1923) 362.
Dysoxylum laxum Merr., Philipp. J. Sc., Bot. 7 (1912) 278; Enum. Philipp. Flow. Pl. 2 (1923) 364; Elmer, Leafl. Philipp. Bot. 9 (1937) 3370. (Syn. nov.).

Small tree 5–10 m; bole to 15 cm diam. Bark smooth, mottled, lenticellate; wood yellowish white (Elmer). Leafy *twigs* ascendant, 3–6 mm diam., cicatrose, lenticellate. Apical buds with fist-shaped leaves, sericeous. *Leaves* 15–40 cm, paripinnate, with caducous, apical spike c. 1 mm long, 3–5-jugate; petiole 3–8 cm, 1.5–3 mm diam., subglabrous to finely sericeous, base swollen and flattened or hollowed adaxially; rachis c. 1.5–2.5 mm diam., subglabrous to finely sericeous. *Leaflets* opposite, the most proximal smallest, 3–9.5 by 1.5–6 cm, narrowly ovate to elliptic, subglabrous to sparsely pubescent on veins abaxially, base weakly asymmetric, acute to cuneate, apex acute to gradually long acuminate; costae c. 10–12 on each side, ± prominent abaxially, weakly arcuate, ± bifid 2/3 from midrib and anastomosing, domatia in axils; petiolules 2–4 mm. *Racemes* or thyrses 5–40 cm long, ± supra-axillary, erect, with few, widely separated flowers, unbranched or basal branches to 6 cm long with 2–7 flowers; axes finely sericeous, delicate; bracts c. 1.5 mm long, narrowly triangular, densely pubescent; pedicels 0.5–3.5 cm with 2 subopposite bracteoles, densely pubescent, c. 0.5 mm long near apex. *Calyx* c. 5 mm long, 4.5 mm diam., cupular, very sparsely sericeous, margin subtruncate to obscurely and irregularly lobed, ciliate, base narrowed into short pseudopedicel articulated with pedicel. *Petals* 4, c. 8–10(–15) mm long, narrowly oblong, somewhat puberulous near apices, white to pinkish, imbricate, ± adnate to staminal tube at base. *Staminal tube* glabrous without, densely villous within, especially near base, margin irregularly 8-lobed, each lobe variously laciniate; anthers 8, c. 1.5 mm long, narrowly oblong, apiculate, glabrous, inserted between lobes and slightly exserted. *Disk* c. 2.5–3 mm long, glabrous, closely enveloping ovary, margin ± irregularly 4-toothed. *Ovary* ± densely pubescent, 4-locular, each locule with one ovule; style terete, ± pubescent in proximal third; stylehead subdiscoid to capitate. *Capsule* c. 2 cm long, 1.5–2 cm diam., obovoid, red, apiculate splitting into four valves, white within. *Seeds* c. 1 cm long, trigonal-convex, covered with thin aril (?sarcotesta). — **Fig. 15.**

Distribution — *Malesia:* Philippines (Luzon, Bohol, Mindanao).
Habitat — Rain forest ridges and riverbanks, 30–1000 m altitude.
Vernacular names — Aman (Mang.), alay (Manobo).

Fig. 15. *Dysoxylum pauciflorum* Merr. a. Habit; b. half flower (*Williams 2925*). Drawing R. Wise.

24. Dysoxylum arborescens (Blume) Miq.

Dysoxylum arborescens (Blume) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 24, incl. f. *ceramicum* Miq. & f. *timorense* Miq.; C.DC., Monogr. Phan. 1 (1878) 489, incl. var. *timorense* (Miq.) C.DC.; King, J. As. Soc. Beng. 64, ii (1895) 38; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 76; Koord., Minah. (1898) 386; F.M. Bailey, Queensl. Fl. 1 (1899) 228; C.DC., Bull. Herb. Boiss. II, 3 (1903) 165; Brandis, Ind. Trees (1906) 138; Backer, Schoolfl. Java (1911) 207; Koord., Exk. Fl. Java 2 (1912) 440; Atlas 1 (1913) t. 174; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320; Ridley, Fl. Malay Penins. 1 (1922) 391; C.E. Parkinson, For. Fl. Andam. (1923) 120; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 362; Baker f., J. Bot. Lond. 61, Suppl. (1923) 7; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 885; Elmer, Leafl. Philipp. Bot. 9 (1937) 3356; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 302; Harms, Bot. Jahrb. 72 (1942) 190, 191; Backer & Bakh. f., Fl. Java 2 (1965) 123; Meijer, Bot. News Bull. Sabah 8 (1967) 80; Chang, Bull. Taiwan Prov. Ping. Inst. Agr. 9 (1968) 3, t. 2; T.D. Penn., Blumea 22 (1975) 506, f. 14b; Corner, Seeds Dicots 1 (1976) 189; 2 (1976) t. 384; Chang, Qu. J. Chin. For. 11 (1978) 73; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 338, t. 257; Mabb. in Tree Fl. Malaya 4 (1989) 242; Hô, Ill. Fl. Vietnam 2, 1 (1992) 489. — *Goniocheton arborescens* Blume, Bijdr. (1825) 177; G. Don, Gen. Syst. 1 (1831) 683 ('*Gonioscheton*'); M. Roem., Synops. Monogr. 1 (1846) 102; Miq., Fl. Ind. Bat. 1, 2 (1859) 540. — *Trichilia arborescens* (Blume) Spreng., Syst. Veg. 4, 2 (1827) 252. — *Alliaria arborescens* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Epicharis kunthiana A. Juss., Bull. Sci. Nat. Géol. 23 (1830) p. after 239 ('238'); Linnaea 6 lit. (1831) 12; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 229, 267; M. Roem., Synops. Monogr. 1 (1846) 102. — *Dysoxylum kunthianum* (A. Juss.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 13; C.DC. in DC., Monogr. Phan. 1 (1878) 488; K. Schum. & Hollr., Fl. Kaiser Wilh. Land (1889) 61; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 161, f. F, G; ibid., ed. 2, 19b1 (1940) t. 35, f. F, G; K. Schum., Notizbl. Bot. Gart. Berlin 2 (1898) 124; K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 380; C.DC., Bull. Herb. Boiss. II, 3 (1903) 165; Perkins, Fragm. Fl. Philipp. (1904) 31; C.T. White, J. Arnold Arbor. 10 (1929) 228; Guillaumin, J. Arnold Arbor. 12 (1931) 238. — *Alliaria kunthiana* (A. Juss.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Hartighsea acuminata Miq., Fl. Ind. Bat., Suppl. (1861) 196, 504.

Hartighsea sumatrana Miq., op. cit. (1861) 196, 505.

Dysoxylum nernstii F. Muell., Fragm. Phyt. Austral. 5 (1865/6) 176; F.M. Bailey, Queensl. Fl. 1 (1899) 231. — *Alliaria nernstii* (F. Muell.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Aglaia halmaheirae Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 58. — *Dysoxylum halmaheirae* (Miq.) C.DC. in DC., Monogr. Phan. 1 (1878) 488, nom. illeg., excl. syn., incl. var. *subobovatum* C.DC. — *Alliaria halmaheirae* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum maingayi Hiern in Hook. f., Fl. Brit. India 1 (1875) 547. — *Alliaria maingayi* (Hiern) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum forsythianum Warb., Bot. Jahrb. 13 (1891) 343 ('*Dysoxylon*'); C.DC., Bull. Herb. Boiss. II, 3 (1903) 168.

Dysoxylum novohebrideanum C.DC., Bull. Herb. Boiss. II, 6 (1906) 983.

Dysoxylum rubrum Merr., Philipp. Govt. Lab. Bur. Bull. 35 (1906) 32; Philipp. J. Sc. 1, Suppl. (1906) 72.

Dysoxylum gjellerupii C.DC., Nova Guinea, Bot. 8 (1914) 1012.

[*Dysoxylum sibuyanense* Elmer, Leafl. Philipp. Bot. 9 (1937) 3376, nom. non rite publ., anglice.]

Treelet or tree to 20(–30) m, but usually less and often flowering when 1 m or so high; bole to 45 cm diam., fluted or with buttresses to 1 m tall and 45 cm out. Bark smooth to weakly cracked, lenticellate, grey-brown to blackish, sometimes mottled; inner bark straw to pale brown; sapwood fawnish. Branching rather fastigiate; crown dense. *Twigs* slender, rough with prominent lenticels, grey-brown, leafy ones c. 3–5 mm diam. *Leaves* to 45 cm long, to 4-jugate, imparinnate, though some leaves pari-

Fig. 16. *Dysoxylum arborescens* (Blume) Miq. Inflorescence. Kalimantan, Bukit Raya (*Nooteboom 4432*). Photograph H.P. Nooteboom, 1983.

pinnate also; petiole to 7 cm long, subterete to weakly angled, glabrous, base swollen, drying blackish. *Leaflets* 8.5–18 by 3–7 cm, most proximal the smallest, elliptical, sometimes narrowly so, to obovate, chartaceous to subcoriaceous, glabrous, bases cuneate, sometimes ± asymmetric, apices conspicuously acuminate, the acumen to 12 mm long, veins 7–9(–10) on each side, spreading, arcuate; petiolules to 6 mm, swollen, drying blackish. *Thyrses* ± axillary, 2–8(–25) cm long, tawny puberulous; branches somewhat congested, ± ascending or subsquarrose, to 5(–12) cm long; bracteoles to 1.5 mm, triangular, tawny pubescent, fugacious. *Flowers* sweetly scented (*Lilium auratum*, Mabberley). *Calyx* c. 2.5–4 mm diam. distally, shallowly cupular, articulated with pedicel by slender pseudopedicel c. 3–6 mm long, ± adpressed fawny pubescent, margin irregularly 5-lobed. *Corolla* weakly clavate in bud, adhering to tube at base; petals (4) 5 (6), c. 7–10 by 1.8–2.2 mm, valvate waxy, creamy green to off white, glabrous or sometimes with minute hairs without, apex boat-shaped. *Staminal tube* weakly adpressed sparsely pubescent within, glabrous without, margin ± truncate to weakly crenulate; anthers 10 (11), c. 1 mm long, inserted near margin. *Disk* c. 1–1.5 mm tall, shortly tubular, ascendant pubescent within, glabrous without, margin crenulate. *Ovary* (3-) 4- or 5-locular, each locule with 2 collateral ovules, pubescent; style terete, ascen-

dant-pubescent in proximal 2/3; stylehead subdiscoid, often dimpled, c. 1 mm diam. *Infructescence* to at least 25 cm long, sometimes appearing terminal, ± erect; axes c. 5 mm diam., ± terete. *Capsule* to 3 cm diam., flattened-globose, (3–)5-valved, often somewhat irregular and weakly angled between valves, bright pink-red, drying black, glabrous; endocarp white within. *Seeds* 1–6, c. 18 by 15 mm, plano-convex, exarillate; seedcoat bright orange, sarcotestal; hilum c. 8 mm diam., white. — **Fig. 16.**

Distribution — Nicobars and Andamans, Taiwan (Lan Yü), Solomon Islands, Queensland, New Hebrides and throughout *Malesia*.

Habitat — A very common tree of primary and secondary forest including that on limestone, to 1500 m altitude, also persisting as a relict in gardens and hedgerows.

Vernacular names — Sumatra: kaju kupang, k. longgajan (Mal.); New Guinea: abungusevarak (Waskuk), ai, bepon (Hattam), meia (Wagu), sagowai (Kebar). Official common name in Philippines: kalimutain.

Uses — None recorded though it would make a good garden tree being early flowering and with beautiful fruits as well as scented flowers.

Note — Despite its wide range, the tree is rather invariable, the numerous variants described being found on different parts of the same tree. Most of the examples I have examined have hermaphrodite flowers.

Galls — Specimens from Borneo and New Guinea often have fasciated proliferating inflorescences, though none with mature flowers has been seen. Similar are known in *Dysoxylum cyrtobotryum* Miq. (q.v.) from Borneo.

25. **Dysoxylum rigidum** (Ridley) Mabb.

Dysoxylum rigidum (Ridley) Mabb., Malays. For. 45 (1982) 450; in Tree Fl. Malaya 4 (1989) 245. — *Chisocheton rigidus* Ridley, Bull. Misc. Info. Kew (1929) 122.

Tree to 30 m; bole to 60 cm diam. with buttresses to 2.5 m tall and 50 cm out. Bark smooth and lenticellate to cracking, reddish grey; inner bark pale yellow to red or brown mottled, weakly onion-scented; sapwood creamy yellow. Leafy *twigs* c. 5 mm diam., cicatrose; buds with tomentose fist-shaped young leaves. *Leaves* 25–55 cm long, 4- or 5-jugate with apical scar, one of the lateral leaflets often appearing terminal; petiole 10–13 cm, c. 3.5 mm diam., conspicuously swollen at base, drying rather blackish like the rachis and petiolules. *Leaflets* 15–20(–28) by 5–8(–17) cm, broadly elliptic-ovate or weakly obovate, coriaceous, glabrous, bases cuneate to obtuse, ± asymmetric, apices acuminate, costae (7–)9–11 on each side, prominent abaxially, sunken adaxially, venation brochidodrome, conspicuously scalariform; petiolules 0.5–1.2 cm, swollen. *Thyrses* to 23 cm, axillary (sometimes in axils of undeveloped leaves), axes finely adpressed fawn pubescent, branches to 16 cm; bracts 2–6 mm, lanceolate, fawn pubescent. *Calyx* c. 6 mm diam., with 3 or 4 lobes c. 4 mm long, ovate, acute, pubescent. *Petals* 5, c. 5–8 mm long, oblong, obtuse, attached to tube at base, finely pubescent without. *Staminal tube* pubescent within, margin subentire; anthers 10, c. 1 mm long, narrowly oblong, glabrous. *Disk* c. 1 mm tall, cupular, fleshy, densely pilose. *Ovary* (?) 5-locular. *Cap-*

sule at least 2.5 cm diam. (Ridley), depressed-globose, sparsely pubescent near sutures, pink to purplish-brown. *Seeds* with bright red coat.

Distribution — *Malesia:* SE Sumatra, Malay Peninsula (Perak, Selangor, Pahang, Johore), Borneo (?Sabah, E Kalimantan). Very rarely collected.

Habitat — Lowland rain forest to 260 m altitude.

Note — The venation is reminiscent of that of *Chisocheton lansiifolius* Mabb., *C. sapindinus* Stevens, *Aglaia oligophylla* Miq. and *Lansium domesticum* Correa.

26. **Dysoxylum alliaceum** (Blume) Blume

Dysoxylum alliaceum (Blume) Blume, Bijdr. (1825) 172; Miq., Fl. Ind. Bat. 1, 2 (1859) 536; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 21; C.DC. in DC., Monogr. Phan. 1 (1878) 482, incl. var. *laxiflorum* (Blume) C.DC.; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 47, incl. var. *lanceolatum* Koord. & Valeton, var. *laxiflorum* (Blume) C.DC. & var. *pauciflorum* Koord. & Valeton; Hochr., Pl. Bogor. Exsicc. (1904) 69, incl. var. *angustifolium* Valeton, var. *genuinum* Valeton (nom. superfl. pro var. *alliaceum*) & var. *lanceolatum* Koord. & Valeton; Busgen, Flora 95 (1905) 74, t. 4; Backer, Schoolfl. Java (1911) 204; Koord., Exk. Fl. Java 2 (1912) 441; Atlas 1 (1913) t. 170; Fl. Tjibodas 2 (1923) 129; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 892; Backer & Bakh. f., Fl. Java 2 (1965) 123; Mabb. in Tree Fl. Malaya 4 (1989) 240. — *Guarea alliacea* Blume apud Nees, Flora 7 (1824) 290. — *Prasoxylon alliaceum* (Blume) M. Roem., Synops. Monogr. 1 (1846) 101, nom. superfl.

[*Guarea foetida* Blume, Bijdr. (1825) 172, nom. nud.]

[?*Guarea axillaris* Blume, l.c., nom. nud.]

Dysoxylum acuminatissimum Blume, Bijdr. (1825) 174; M. Roem., Synops. Monogr. 1 (1846) 101; Miq., Fl. Ind. Bat. 1, 2 (1859) 536. — *Dysoxylum aculeatissimum* Steud., Nomencl., ed. 2, 1 (1840) 534, sphalm. pro *D. acuminatissimum* Blume. — *Alliaria acuminatissima* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 108.

Dysoxylum laxiflorum Blume, Bijdr. (1825) 174; G. Don, Gen. Syst. 1 (1831) 683; M. Roem., Synops. Monogr. 1 (1846) 101; Miq., Fl. Ind. Bat. 1, 2 (1859) 537.

Dysoxylum longifolium Blume, Bijdr. (1825) 173; M. Roem., Synops. Monogr. 1 (1846) 101; Miq., Fl. Ind. Bat. 1, 2 (1859) 536.

?*Dysoxylum simile* Blume, Bijdr. (1825) 174; G. Don, Gen. Syst. 1 (1831) 683; M. Roem., Synops. Monogr. 1 (1846) 101; Miq., Fl. Ind. Bat. 1, 2 (1859) 537; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 23; C.DC. in DC., Monogr. Phan. (1878) 525; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 67; Backer, Schoolfl. Java (1911) 206; Koord., Exk. Fl. Java 2 (1912) 442; Atlas 1 (1913) t. 180; Backer & Bakh. f., Fl. Java 2 (1965) 123. — ?*Trichilia similis* (Blume) Spreng., Syst. Veg. 4, 2 (1827) 252. — ?*Alliaria similis* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 108.

Trichilia alliacea auct. non Forst.: Spreng., Syst. Veg. 4, 2 (1827) 252, p.p.

Dysoxylum lamponga Miq., Fl. Ind. Bat., Suppl. (1861) 196, 503. — *Alliaria lamponga* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 108.

Hartighsea costulata Miq., Fl. Ind. Bat. 1, 2 (1859) 505. — *Dysoxylum costulatum* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 21; C.DC. in DC., Monogr. Phan. 1 (1878) 503; King, J. As. Soc. Beng. 64, ii (1895) 43; Ridley, Fl. Malay Penins. 1 (1922) 394; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 885; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 893. — *Alliaria costulata* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum fraternum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 25; C.DC. in DC., Monogr. Phan. 1 (1878) 483; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 54; Backer, Schoolfl. Java (1911) 204; Koord., Exk. Fl. Java 2 (1912) 441. — *Alliaria fraterna* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum excelsum Blume var. *glabriflorum* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 20; C.DC. in DC., Monogr. Phan. 1 (1878) 752 ('*glaberrimum*').

Dysoxylum brevipes Hiern in Hook. f., Fl. Brit. India 1 (1875) 546; C.DC., op. cit. (1878) 503.

Dysoxylum thyrsoideum Hiern, op. cit. (1875) 547; C.DC., op. cit. (1878) 481; King, J. As. Soc. Beng. 64, ii (1895) 42, incl. var. *andamanicum* King; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320; Ridley, Fl. Malay Penins. 1 (1922) 393; C.E. Parkinson, For. Fl. Andam. (1923) 120, incl. var. *andamanicum* King; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 886; Harms, Notizbl. Bot. Gart. Berl. 15 (1941) 478. — *Alliaria thyrsoidea* (Hiern) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum glabrum C.DC. in DC., Monogr. Phan. 1 (1878) 483; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 53; Backer, Schoolfl. Java (1911) 204. — *Alliaria glabra* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum miquelianum C.DC., op. cit. (1878) 488. — *Alliaria miqueliana* (C.DC.) Kuntze, l.c.

Dysoxylum nagelianum C.DC., op. cit. (1878) 504; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 55; Backer, Schoolfl. Java (1911) 204; Koord., Exk. Fl. Java 2 (1912) 441. — *Alliaria nageliana* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum vrieseanum C.DC., op. cit. (1878) 491; Backer, Schoolfl. Java (1911) 207. — *Alliaria vrieseana* (C.DC.) Kuntze, l.c.

Amoora oligosperma Pierre, Fl. For. Coch. (1897) t. 345A; Pellegr. in Fl. Indo-Chine, Suppl. 1 (1948) 718; Hô, Ill. Fl. Vietnam 2, 1 (1992) 496. — *Aglaia oligosperma* (Pierre) Pellegr. in Fl. Indo-Chine 1 (1911) 775.

Dysoxylum klemmei Merr., Philipp. J. Sc., Bot. 4 (1909) 273; Enum. Philipp. Flow. Pl. 2 (1923) 364.

Dysoxylum platyphyllum Merr., Philipp. J. Sc., Bot. 8 (1913) 375; Enum. Philipp. Flow. Pl. 2 (1923) 365; Elmer, Leafl. Philipp. Bot. 9 (1937) 3373.

Dysoxylum euphlebium Merr., Philipp. J. Sc., Bot. 9 (1914) 305; Int. Rumph. (1917) 308; Enum. Philipp. Flow. Pl. 2 (1923) 363; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 894.

Dysoxylum rostratum Merr., Philipp. J. Sc., Bot. 9 (1914) 304; Enum. Philipp. Flow. Pl. 2 (1923) 365; Elmer, Leafl. Philipp. Bot. 9 (1937) 3376.

Dysoxylum pulchrum Ridley, J. As. Soc. Str. Br. 75 (1917) 17; Fl. Malay Penins. 1 (1922) 395.

Chisocheton dempoense Baker f., J. Bot. 62, Suppl. (1924) 18. — *Dysoxylum dempoense* (Baker f.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 166, 176. (Syn. nov.).

[*Dysoxylum lanceolatum* Elmer, Leafl. Philipp. Bot. (1937) 3368, nom. inval.]

[*Dysoxylum apoense* Elmer, op. cit. (1937) 3355, nom. inval.]

Dysoxylum archboldianum Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 305. (Syn. nov.).

Dysoxylum sattelbergense Merr. & L.M. Perry, op. cit. (1940) 304. (Syn. nov.).

Dysoxylum brachycalycinum Harms, Bot. Jahrb. 72 (1942) 192. (Syn. nov.).

Dysoxylum monticola Harms, Bot. Jahrb. 72 (1942) 197. (Syn. nov.).

[*Alliaria* Rumph., Herb. Amb. 2 (1741) 81, t. 20.]

Tree to 38 m, often of poor form; bole to 80 cm diam., fluted to c. 4 m with buttresses to 60 cm tall and 1 m out. Bark thin, lenticellate to finely fissured and shedding irregular strips; inner bark red-brown, yellower within, usually with strong smell of onions; sapwood fawnish; heartwood red-brown. *Twigs* cicatrose, striate, elenticellate. Leafy twigs c. 5–8 mm diam.; apical buds with fist-shaped young leaves, ± pubescent. *Leaves* to 60(–120) cm, usually smelling of onions when crushed, 3–6(–8)-jugate, subglabrous, subcoriaceous, petiole 5–15 cm, flattened adaxially, weakly swollen at base. *Leaflets* 7.5–25 by 2.5–7.5 cm, elliptic or ovate, or subfalcate, opposite to subopposite with an apical pair or one of these appearing terminal and with a small apical scar, shiny dark green adaxially, bases ± asymmetric, apices acuminate, nerves 8–12(–14) on each side, arcuate, subprominent abaxially; petiolules 5–20 mm, sulcate. *Thyrses* to 40 cm, pyramidal, proximal branches 8–20 cm with branchlets to 5 cm, bearing cymules of 1–3 sweetly scented flowers; axes puberulous; bracts and bracteoles minute. Flowerbuds with truncate apices, oblong; pedicels 2.5–4 mm long. *Calyx* c. 2.5–3 mm diam., shal-

lowly cupular or salveriform, glabrous to subpuberulous without, margin 4-toothed. *Petals* 4 or 5, 5–8 mm long, linear, valvate, glabrous or pubescent within, white, or pinkish, drying black. *Staminal tube* glabrous or puberulous without, ± hairy within, margin subtruncate to 8- (or 10-)denticulate; anthers 8 (10), c. 1 mm long, included. *Disk* c. 1 mm tall, ± pubescent on both sides, truncate to obscurely lobed, margin ciliate. *Ovary* glabrous to hirsute, 3-locular, each locule 2-ovulate, style terete; stylehead subdiscoid, ± dimpled. *Infructescence* ± branched, to 25 cm long. *Capsule* to 7.5 cm diam., subglobose or lobed and constricted between seeds or beaked, occasionally markedly so (the beak to 15 mm) when 1-seeded, greenish white when unripe, red at maturity, drying black. *Seeds* 1–4 per capsule; oblong-globose, testa red, exarillate, when cut producing white latex and usually strong smell of onions; cotyledons superposed to collateral.

Distribution — Andamans and peninsular Thailand, throughout *Malesia* to the Solomon Islands and Queensland.

Habitat — Rain forest, including that on limestone, to 1800 m altitude.

Vernacular names — Most names applied to this species are also used for others, e.g. ki bawang (Sumatra) and pingku (Java), while in the Malay Peninsula the name kulim is used though this is more properly applied to *Scorodocarpus* (*Olacaceae*), with which it shares the strong onion smell when cut.

Uses — The timber is utilized but is not greatly valued. The strongly scented leaves have been said to be used to flavour food in New Guinea.

Notes — 1. This is a polymorphic species which cannot be readily subdivided formally. It is closely related to *Dysoxylum excelsum* Blume, sterile material of the two being particularly difficult to separate. Large-flowered forms of *D. alliaceum* approach the small-flowered forms of *D. excelsum*, though the latter never have the onion smell, have larger bracts and bracteoles and generally smaller infructescences than *D. alliaceum*. Furthermore, in the Moluccas and Lesser Sunda Islands, materials have been collected of trees which have fruits resembling more those of *D. excelsum* but flowers like *D. alliaceum*. These include *Kuswata & Soepadmo 56 & 185* from West Ceram, *Kostermans 18096, 18193, 18284, 18289, 18369, 18620, 18748, 19068, 19080, 19095, 19158* (all from Mt Batulanteh and at L) and *Schmutz 2808* from Flores. These might be considered worthy of specific rank, but in view of the complex nature of both *D. alliaceum* and *D. excelsum*, it is my opinion that to recognize such a species would be irresponsible. Nevertheless, there are forms on Sumbawa at least more typical of both *D. alliaceum* and *D. excelsum*.

2. The type of *Dysoxylum dempoense* is a very delicate twig though, in all other respects apparently fitting here.

3. In north-east New Guinea, more clearly isolated within this complex, however, is the following:

26a. **Dysoxylum hapalanthum** Harms

Dysoxylum hapalanthum Harms, Bot. Jahrb. 72 (1942) 193.
?*Dysoxylum bamleri* Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 380.

Specimens seen include, e.g.: Bulolo, *Mabberley 1723* (FHO, K, L), *1752* (FHO, L), *NGF 3587* (L, LAE), *3595* (BM, FHO, K, L, LAE), *4012* (FHO, K, L), *7345* (K, L, LAE), *17066* (K, L, LAE), *17130* (K, L, LAE), *26369* (L), *Pennington 8075* (FHO, KEP, L), *8080* (FHO, KEP, L); 'Djamu', *Schlechter 16827* (B, iso); and (?) Madang, *Saunders 948* (L).

This would seem to be a satellite like *Dysoxylum hongkongense* (Tutch.) Merr. of tropical China and approaching *D. excelsum* and *D. klanderi* F. Muell. of tropical Australia. However, unlike with those, which are at the geographical margins of the complex, it is difficult to pinpoint a clearly distinguishing character, though the overall facies and the intensely overpowering garlic smell in both live and long dead material, which dries to a very bilious pale brown, mark it out; the fruits are often very irregular in form.

27. **Dysoxylum excelsum** Blume

Dysoxylum excelsum Blume, Bijdr. (1825) 176; G. Don, Gen. Syst. 1 (1831) 683; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 19, incl. var. *hasseltii* Miq.; C.DC. in DC., Monogr. Phan. 1 (1878) 752; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 56, incl. var. *genuinum* Koord. & Valeton, nom. superfl., var. *parvifolium* Koord. & Valeton & var. *pedicellatum* Koord. & Valeton; Backer, Schoolfl. Java (1911) 207; Volkens, Laubfall (1912) 29; Koord., Exk. Fl. Java 2 (1912) 441; Atlas 1 (1913) t. 171; Fl. Tjibodas 2 (1923) 129; Merr., Contr. Arnold Arbor. 8 (1934) 81; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 886; Backer & Bakh. f., Fl. Java 2 (1965) 124; Mabb. in Tree Fl. Malaya 4 (1989) 244; Zou, Acta Bot. Yunnan. 11 (1989) 157. — *Trichilia excelsa* Spreng., Syst. Veg. 4, 2 (1827) 252, excl. syn. Jack. — *Hartighsea excelsa* (Blume) A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 228, excl. syn. Jack; Miq., Fl. Ind. Bat. 1, 2 (1859) 538, excl. syn. Jack. — *Macrocheton excelsum* (Blume) M. Roem., Synops. Monogr. 1 (1846) 104 ('*Macrochiton*').

[?*Azedarach nigra* Noronha, Verh. Bat. Genoot., ed. 5, 1 (1791) art. 4, 5, nom. nud.; cf. Hassk., Cat. Hort. Bogor. (1844) 221.]

[*Guarea procera* Wall., Cat. (1829) n. 1261, nom. nud.]

[*Guarea oblonga* Wall., Cat. (1829) n. 1262, nom. nud.]

[?*Guarea acuminata* Wall., Cat. (1829) n. 1263, nom. nud.]

Guarea gobara [Aiken, Trans. Soc. Arts Manuf. Comm. 48 (1831) 456, 480, nom. nud.;] Buch.-Ham., Mem. Wern. Soc. 6 (1832) 306; Wall., Cat. (1831/2) n. 4885. — *Dysoxylum gobara* (Buch.-Ham.) Merr., J. Arnold Arbor. 23 (1942) 173; How & Chen, Acta Phytotax. Sin. 4 (1955) 12; Wu, Fl. Yunnan. 1 (1977) 244, t. 58, f. 1–3; Debnath & Sreek., J. Econ. Tax. Bot. 16 (1992) 219; Hô, Ill. Fl. Vietnam 2, 1 (1992) 490. (Syn. nov.). — [*Hartighsea gobara* Wight & Arn. ex Voigt, Hort. Suburb. Calc. (1845) 136, nom. nud.] — *Dysoxylum procerum* Hiern in Hook. f., Fl. Brit. India 1 (1875) 547, nom. illeg.; C.DC. in DC., Monogr. Phan. 1 (1878) 486, incl. var. *integrum* C.DC. & var. *motleyanum* C.DC.; Theob. in Mason, Burma, ed. 4, 2 (1883) 582; C.DC., Bull. Herb. Boiss. II, 2 (1894) 578, incl. var. *macranthum* C.DC.; Prain, Beng. Pl. 1 (1903) 220; Brandis, Indian Trees (1906) 138; Pellegr. in Fl. Indo-Chine 1 (1911) 744, t. 81, f. 6–11; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320, incl. var. *motleyanum* C.DC.; Craib, Fl. Siam. Enum. 1 (1926) 252; Lecomte, Bois Indoch. (1927) 134; Hand.-Mazz., Symb. Sin. 7 (1933) 632; Kanj. et al., Fl. Assam 1, 2 (1936) 231. — *Alliaria procera* (Hiern) Kuntze, Rev. Gen. Pl. 1 (1891) 109, nom. illeg. — *Epicharis procera* (Hiern) Pierre, Fl. For. Coch. 5 (1896) sub t. 348, nom. illeg.

Guarea disyphonia Griff., Notul. 4 (1854) 503; Ic. 4 (1854) t. 585A, f. 1.

[*Epicharis dubiosa* Span. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 20, nom. in syn.]

Dysoxylum macrothyrsum auct. non Miq.: Miq., l.c., quoad spec., nec nom. (illeg.) non syn.; C.DC. in DC., Monogr. Phan. 1 (1878) 485; Ridley, Fl. Malay Penins. 1 (1922) 394, incl. var. *microbotrys* (King) Ridley.

Dysoxylum arnoldianum K. Schum. in K. Schum. & Hollr., Fl. Kaiser Wilh. Land (1889) 61. (Syn. nov.).
Dysoxylum turbinatum King, J. As. Soc. Beng. 64, ii (1895) 43; Ridley, Fl. Malay Penins. 1 (1922) 394.
Dysoxylum microbotrys King, op. cit. (1895) 48.
Dysoxylum hasseltii (Miq.) Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 64; Backer, Schoolfl. Java (1911) 207; Koord., Exk. Fl. Java 2 (1912) 442; Atlas 1 (1913) t. 177. — *Dysoxylum excelsum* Blume var. *hasseltii* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 19.
Dysoxylum macgregorii C.DC., Bull. Herb. Boiss. II, 3 (1903) 164.
Dysoxylum altissimum Merr., Philipp. Govt Lab. Bur. Bull. 17 (1904) 25; Philipp. J. Sc. 1, Suppl. (1906) 72; Robins., Philipp. J. Sc., Bot. 6 (1911) 207; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 362; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 337, t. 256. (Syn. nov.).
?*Dysoxylum pallidum* Merr., Philipp. J. Sc., Bot. 9 (1914) 366; Enum. Philipp. Flow. Pl. 2 (1923) 364.
Dysoxylum motleyanum (C.DC.) Ridley, Bull. Misc. Info. Kew (1930) 364. — *Dysoxylum procerum* Hiern var. *motleyanum* C.DC. in DC., Monogr. Phan. 1 (1878) 485.
Dysoxylum havilandii Ridley, Bull. Misc. Info. Kew (1930) 365. (Syn. nov.).
Dysoxylum huberti Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 476.
Dysoxylum peerisiae Kosterm., Acta Bot. Neerl. 31 (1982) 322 ('*peerisii*').

Tree to 36 m; bole to 80 cm diam., buttressed to 3 m, buttresses reaching 2.5 m out, concave. Bark smooth to slightly flaking, lenticellate; inner bark reddish brown with resinous smell; sapwood fawnish white; heartwood brownish-red. Leafy *twigs* 5–9 mm diam., lenticellate, ± pubescent when young; apical bud with fist-shaped leaves. *Leaves* 25–90 cm, 2–4(–5)-jugate, ± paripinnate with terminal scar; petiole 5–10 cm, ± puberulent, ± flattened adaxially, weakly swollen at base. *Leaflets* (the most distal the largest) 10–25(–51) by 4–10(–21) cm, ovate-elliptic to -lanceolate, subcoriaceous, glabrous to rufescent-pubescent abaxially, especially on venation, opposite to alternate, bases rather symmetrical, acute to attenuate, apices obtuse to acuminate, costae 9–12 on each side, arcuate, obscurely anastomosing at margin, impressed adaxially, prominent abaxially like the midrib in sicco; petiolules 5–15 mm, sulcate in sicco. *Thyrse* up to 1 m long but usually less and sometimes (in females) as short as 10 cm, axillary to supra-axillary; axes ± densely rufescent pubescent, most proximal branches to 20 cm with secondary branches to 3 cm, bearing cymules of 1–3 sweetly scented (jasmine, honeysuckle) flowers; bracts c. 1.5 mm, triangular, pubescent; pedicels c. 1 mm, articulated with pseudopedicel up to 3 mm. *Calyx* continuous with pseudopedicel, c. 1–2 mm long, 4–5 mm diam., shallowly cupular, pubescent without, pinkish, margin rather irregularly 4- (or 5-)toothed. *Petals* 4 (5), 6–15 by 3–4 mm, narrowly oblong, valvate, minutely sericeous without, creamy or pinkish white. *Staminal tube* glabrous or weakly puberulent within or without, white, margin truncate to weakly 8- (or 10-)crenate; anthers 8 (10), c. 1 mm long, included, glabrous. *Disk* up to half as long as staminal tube, with descending hairs within and c. 8- (or 10-)toothed margin, markedly pilose. *Ovary* densely sericeous, 3- or 4-locular, each locule with 1 or 2 ovules; style glabrous in distal half, otherwise sericeous; stylehead discoid to subcapitate. *Capsule* up to 5(–7.5) cm diam., 4 cm long, flattened globose to pyriform, 3- or 4-lobed, glabrous to scurfy, chestnut brown when ripe. *Seeds* 1–4, c. 2.5 cm long, 1.5 cm wide, subreniform, pendent on funicles at fruit dehiscence, testa bright red; hilum white.

Distribution — Sri Lanka (Sinharaja Forest), Nepal and NE India, Andamans, S China and Indochina, throughout *Malesia* to Solomon Islands, with a very closely allied species (*Dysoxylum klanderi* F. Muell.) in Queensland, but so far unrecorded from the Bismarck Archipelago.

Habitat & Ecology — Rain forest including riverine and swamp forest and that on limestone, to 1000 m altitude. Fruit said to be poisonous (*BNB 10391*) but attractive to pigeons (Motley).

Vernacular name — Official common name in Philippines: kulig-baboi.

Uses — Timber of little esteem but used for general construction work.

Note — *Dysoxylum excelsum* in my opinion is a complex of forms insufficiently differentiated from one another to make an arrangement of closely related species or, indeed, of infraspecific taxa associated with differences in geography or ecology, of which we have, at this time, insufficient knowledge. Nevertheless, there are distinctive trends within the complex although the floral differences are rather insignificant. The flowers of the material from mainland Asia are the largest and are associated with a generally larger vegetative morphology, though some material from Sumatra is almost as robust. In Java there is a range of flower size leading Backer & Bakhuizen f. (l.c.) to note 'Variable!', for the smallest approach the flowers of *Dysoxylum alliaceum* to which this complex is intimately allied. Small flowers are also found in New Guinea, where they are often associated with small thyrses and a rather delicate twig (*D. arnoldianum*), but such materials can be matched by others from Borneo. In the latter island are some rather pubescent forms (*D. havilandii*) but these can be matched with materials from Java, Sumatra, Malay Peninsula as well as mainland Asia. In the Solomon Islands are specimens with large flowers with rather weakly hairy petals and the overall facies of *D. alliaceum* and, indeed, I have not always been able to distinguish clearly fruiting material of these two taxa in that archipelago. Even more perplexing is the state of affairs in the Moluccas and the Lesser Sunda Islands, where materials resemble *D. excelsum* in fruit but *D. alliaceum* in flower; these are discussed under the latter species.

28. **Dysoxylum phaeotrichum** Harms

Dysoxylum phaeotrichum Harms, Bot. Jahrb. 72 (1942) 198.

Sparsely branched treelet 2–3(–8) m; bole to 2 cm diam. Leafy *twigs* c. 7–12 mm diam.; lenticellate, tomentose; apical buds with fist-shaped young leaves, densely tawny tomentose. *Leaves* 50–75 cm, 5- or 6-jugate with apical scar; petiole 15–20 cm, flattened to grooved adaxially in sicco, hollowed adaxially and swollen at base, lenticellate, finely pubescent. *Leaflets* subopposite to alternate, the subapical the largest, 25–38 by 10–12 cm, lanceolate to oblong, the most proximal 10–13 by 4–5 cm, ± ovate, glabrous adaxially, softly pubescent abaxially, especially on midrib and nerves, bases acute, apices shortly acuminate, nerves 15–20 on each side, acute, scarcely arcuate, inarched and looped at extreme margin, ± prominent on both surfaces in sicco, secondary venation subscalariform, petiolules 4–15 mm, swollen basally. *Thyrse* to 58 cm, with branches to

10(–25) cm in male, bearing subopposite cymules of 1–3 flowers; axes densely tawny pubescent; bracts 5–18 by 1–1.5 mm, subulate; bracteoles c. 1 mm, triangular, densely pubescent; pedicels c. 1 mm, articulated with short pseudopedicel, densely pubescent. *Calyx* c. 2.5 mm long, 3–4 mm diam., cupular, 4- or 5-lobed to half way, densely pubescent, the lobes broadly triangular, acute. *Petals* 4, c. 11 mm long, narrowly elliptic, densely adpressed pubescent, creamish, valvate, apex acute. *Staminal tube* glabrous, tough, margin weakly crenulate; anthers 8, c. 1.2 mm long, boat-shaped, glabrous, included, apiculate, weakly locellate. *Disk* c. 2.5 mm long, cylindrical, densely pilose within and apically without, margin 8- (or 9-)crenate, strigose. *Ovary* subglabrous to adpressed pubescent; 4-locular, style terete, proximally ± adpressed pubescent; stylehead short-cylindrical. *Infructescence* to 63 cm, flagelliform; axis densely tomentose. *Capsules* to at least 3 cm diam., subglobose or depressed globose, very shortly stipitate, pink, ± weakly pilose, 4-valved, white within, congested in distal 1/4 of axis. *Seeds* 2–4, c. 2 cm long, 1.2 cm diam., ellipsoid; testa blood red (tasteless but weakly astringent, Jacobs); hilum c. 8 mm long, oval.

Distribution — *Malesia:* New Guinea (restricted to a few sites in the centre of the island).

Habitat — Primary rain forest, to 700 m altitude.

Note — The habit of this tree resembles that of *Dysoxylum sessile* Miq. and sect. *Clemensia* of *Chisocheton*, with which it shares the flagelliform infructescence.

29. Dysoxylum angustifolium King

Dysoxylum angustifolium King, J. As. Soc. Beng. 64, ii (1895) 39; Ridley, Fl. Malay Penins. 1 (1922) 392; Corner, Wayside Trees 1 (1940) 461, t. 153; Steenis, Rheophytes (1981) 291, t. 33; Allertonia 4 (1987) 312 cum tab. (inverted); Corner, Wayside Trees, ed. 3, 2 (1988) 501, t. 156; Mabb. in Tree Fl. Malaya 4 (1989) 242.

Dysoxylum alliaceum (Blume) Blume var. *laxiflorum* Ridley, Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 285.

Riparian rheophytic tree to 9 m, branching low down, bushy and straggly; bole to 10 cm diam. Bark grey. Leafy *twigs* c. 4–8 mm diam.; buds densely adpressed fawn-pubescent, with fist-shaped young leaves. *Leaves* 15–30 cm, paripinnate, 4- or 5(–7)-jugate, with terminal spike c. 2 mm long, or its scar, glabrous. Petiole c. 4.5 cm, terete to angled when dried. *Leaflets* 8.5–21 by 1.5–2.5 cm, opposite, very narrowly elliptic, glossy adaxially, bases cuneate, apices long acuminate, midrib sunken adaxially, prominent abaxially, costae c. 10 on each side, ascendant, not looped; petiolules 3–6 mm, swollen, drying blackish. *Thyrses* to 1 m, ± axillary, ± glabrous, sparsely branched, branches to 4 cm; bracteoles to 1 mm, triangular, tawny pubescent, persistent, apparently in opposite pairs. *Flowers* onion-scented. *Calyx* c. 2.5 mm diam., decurrent into pseudopedicel c. 3 mm long, articulated with pedicel, free part c. 1 mm deep, shallowly cupular, irregularly 4-lobed, shortly hairy without. *Petals* 4, 16–20 by 2.5–4 mm, linear-oblong, ± puberulous on both surfaces, white, valvate, weakly connate proximally, apices boat-shaped. *Staminal tube* glabrous, margin obscurely 8-lobed; anthers 8, c. 1 mm long, glabrous. *Disk* c. 4 mm long, cylindrical with fluted mouth, glabrous to sparsely

pubescent on both surfaces. *Ovary* densely adpressed pubescent, 4-locular, each locule with 2 ovules; style 4-angled, puberulous; stylehead c. 1 mm diam., discoid, dimpled. *Infructescence* to 1 m long. *Capsules* ± aggregated in distal part of infructescence, c. 7 cm diam., depressed-obovoid, whitish becoming pale purplish pink, downward-pointing, 4-valved. *Seeds* (1) 2–6 (1 long or 2 short per locule), to 4 by 2 cm, plano-convex, exarillate, dangling from fruit on white strands 1–2 cm; sarcotesta bright orange-red.

Distribution — *Malesia:* restricted to the river systems on the east of the Malay Peninsula.

Habitat & Ecology — A common component of the neram vegetation of rivers, growing amongst the rocks and on the banks, to 300 m altitude. See also paragraph on Uses below.

Vernacular names — Kulim ayer, though kulim is generally used for *Scorodocarpus* spp. with which it shares the onion smell.

Uses — The seeds have been used as fish bait though they are said to make the fish flesh unpalatable (Corner, l.c.). It is believed that the fish disperse the seeds, much as *Gonystylus bancanus* (*Thymelaeaceae*) is distributed by a small catfish in the peat-swamp forest of Sarawak, where the fish flesh also has a strange flavour after ingestion of the seeds [see Mabberley, Tropical rain forest ecology (1983) 105–106]. The related *Guarea guidonia* (L.) Sleumer of tropical America is thought to be fish-dispersed and possibly *Aglaia yzermannii* also. The latter grows with *Dysoxylum angustifolium* and greatly resembles it in general form (see Steenis, l.c.) but it differs most obviously in its lesser stature, smaller, imparipinnate leaves with fewer leaflets, tiny flowers and small indehiscent orange-pink fruits each with 2 seeds.

30. **Dysoxylum magnificum** Mabb.

Dysoxylum magnificum Mabb., Blumea 38 (1994) 309, f. 5.

Tree to 15(–25) m; all parts onion-scented when bruised; bole to 25 cm diam., fluted with buttresses to 30 cm tall and out. Bark smooth to cracking into small blocks, often hooped and with prominent brown lenticels, brownish; inner bark pinkish brown; sapwood pale cream. *Twigs* smooth to striate, pale brown, leafy ones c. 9–12 mm diam., rusty-brown velutinous when young; buds densely velutinous, young leaves fist-shaped. *Leaves* to 1 m long, in lax terminal spirals; petiole 8–14 cm, flattened to channelled adaxially, ± densely velutinous, swollen at base. *Leaflets* 5 or 6 on each side, opposite to alternate, one often appearing apical through fall of spike, leaving scar on other side, the largest the most distal, 17–29 by 6–14 cm, oblong, somewhat coriaceous, glossy and glabrous save sometimes midrib pubescent adaxially, brown velutinous abaxially, especially on veins, bases obtuse, apices shortly acuminate to cuspidate, veins ± sunken adaxially and prominent abaxially, costae c. 12–14 on each side, obtuse, inarching only at margin, some secondary ones, particularly proximally, almost as conspicuous, tertiary venation subscalariform; petiolules 4–8 mm, somewhat sulcate. *Thyrses* to 60 cm, unbranched or with few subsquarrose branches to 10 cm; axes ± densely brown velu-

tinous; bracteoles 4–6 mm, lanceolate, densely pilose. *Calyx* c. 2.5 mm long, 5 mm diam., shallowly cupular, ± velutinous without, margin ± irregularly 5-crenate. *Petals* 5, c. 12 by 2.5 mm, narrowly spathulate, valvate, white, densely adpressed pubescent without, tips acute, thickened. *Staminal tube* white, glabrous, margin subcrenulate; anthers 10, c. 1.5 mm long, narrowly oblong, sublocellate, glabrous, inserted c. 3 mm within tube, free filament c. 0.5 mm. *Disk* c. 2.5 mm long, cylindrical, densely adpressed hairy on both surfaces. *Ovary* densely adpressed hairy, (?) 3-locular, each locule (?) 2-ovulate; style terete, adpressed pubescent; stylehead capitate c. 0.8 mm diam. *Capsule* up to at least 8 cm diam., flattened-globose, deeply sunken between the 2 or 3 fertile locules, brown and velvety when young, pale cream when riper. *Seeds* c. 2 cm diam., subhemispherical, flattened adaxially, covered with shining thick sarcotesta (?), pink when mature.

Distribution — *Malesia:* SE Sumatra, Borneo (Sarawak).

Habitat — Rain forest, to 500 m altitude.

31. **Dysoxylum brassii** Merr. & L.M. Perry

Dysoxylum brassii Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 309.
Dysoxylum ledermannii Harms, Bot. Jahrb. 72 (1942) 194. (Syn. nov.).

Tree to 25(–35) m with clear bole to 18 m, (25–)40(–75) cm diam., buttressed to 2.5 m. Bark smooth with pustular lenticels to irregularly finely flaking, red- or grey-brown; inner bark mottled red-brown and purplish, darkening on exposure, weak reddish exudate; sapwood cream; heartwood pale red-brown. *Twigs* stout, pithy, greyish, cicatrose, usually brown pilose when young, occasionally myrmecophilous. Leafy twigs c. 11–13 mm diam.; buds with fist-shaped young leaves. *Leaves* to 80 cm long, 5–7-jugate with terminal spike or its scar, one lateral leaflet often appearing terminal; petiole 8–25 cm, ± brown pubescent, flattened to shallowly channelled adaxially. *Leaflets* oblong or ovate, the largest the most distal, 20–40 by 8–15 cm, glabrous and shiny or with finely hairy venation, especially on midrib where brownish, adaxially sericeous to brown pilose abaxially, particularly on veins, bases ± asymmetric, obtuse to rounded or subcordate, apices shortly acuminate, costae c. 18–21 on each side, spreading, inarched but not looped at margin, secondary veins sometimes almost as conspicuous, tertiary venation subscalariform, often prominulous; petiolules 5–13 mm, often sulcate. *Thyrses* 10–13 cm, patent, borne in axils of leaves or cicatrices, sometimes ± supra-axillary; axes ± conspicuously brown pilose, often woody and stout, branching ± decussate, branches to 15 cm long, bearing congested branchlets of cymules; bracts c. 1.5 mm long, triangular, pubescent. *Flowers* subsessile, fragrant. *Calyx* 4–5 mm long and in diam., cupular, densely adpressed pubescent without, margin 4-lobed to 1/3 length. *Petals* 4, 13–15 mm, cream, densely sericeous without. *Staminal tube* glabrous, margin subtruncate; anthers (7) 8, c. 1.5 mm long, narrowly ovate, inserted well inside tube with free filament c. 0.5 mm. *Disk* 4–5 mm tall, villous apically within and on fimbriate pale green margin. *Ovary* 4-locular, densely sericeous; style densely sericeous in proxi-

mal half; stylehead capitate. *Capsule* c. 3.5 cm long, 3 cm diam., subpyriform, brownish, to whitish when mature, drying reddish minutely pubescent; pericarp with white latex (Pennington), constricted between seeds. *Seeds* oblong, c. 2 cm long, without aril.

Distribution — *Malesia:* New Guinea (Jayapura, Geelvink Bay, northeast and southeast to Fergusson Islands).

Habitat — Rain forest, to 1400 m altitude.

Vernacular names — Meireit, merek (Manikiong).

Note — This species has much in common with *Dysoxylum magnificum*. Merrill and Perry described a fruiting specimen, Harms flowering ones. *Moll BW 11611* from Warsamson Valley, E of Sorong, is very galled with a huge apical bud c. 4 cm diam. and may belong here though the collector refers to a strongly laticiferous bark.

32. **Dysoxylum randianum** Merr. & L.M. Perry

Dysoxylum randianum Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 306.
Dysoxylum sericopetalum Harms, Bot. Jahrb. 72 (1942) 201, e descr.

Tree 15–35 m; bole to 50 cm diam. Bark dark brown to black; inner bark bright red-brown, odorous; sapwood creamish; heartwood light brown. Leafy *twigs* 5–6 mm diam. *Leaves* to 30(–100) cm, 5–7-jugate with apical spike or scar and one lateral leaflet often appearing terminal; petiole (4–)8–12 cm, weakly angled to grooved adaxially, ± minutely adpressed pubescent. *Leaflets* 10–18(–25) by 5–9 cm, elliptic-oblong, opposite to alternate, subglabrous to finely adpressed pubescent abaxially, particularly on veins, shiny adaxially, bases asymmetric, obtuse to rounded, apices obtuse to weakly acuminate; costae 14–20 on each side, the intercostals sometimes almost as conspicuous, obtuse, spreading, not looped together even at margin, sunken adaxially, prominent abaxially; petiolules 1–2 cm, sometimes weakly swollen at base. *Thyrses* to 20 cm, weakly supra-axillary; branches to 8 cm, subsquarrose bracteoles 3–5 mm, lanceolate to subfoliose, adpressed pubescent. *Flowers* subsessile, pinkish in bud. *Calyx* c. 2 mm deep, 3 mm diam., 4- or 5-lobed to 1/3, adpressed pubescent without. *Petals* 4, c. 9 mm long, narrowly spathulate, valvate, creamish, adpressed pubescent without, apices acute, thickened. *Staminal tube* glabrous, margin crenulate; anthers 8, c. 1 mm long, glabrous, inserted c. 1.5 mm within tube, free filament c. 0.5 mm. *Disk* c. 6 mm long, narrowly urceolate, densely sericeous without, margin crenate to 8-lobed with impressions of anthers, slightly widened. *Ovary* adpressed sericeous, 4-locular, each locule (?) 2-ovulate; style terete, subglabrous; stylehead spherical. *Capsule* subglobose, very shortly beaked, pubescent (unripe). *Seeds* oblong; seedcoat coriaceous; cotyledons collateral (Merrill & Perry, l.c.).

Distribution — *Malesia:* New Guinea.

Habitat — Hill and submontane rain forest, 850–2000 m altitude.

Note — I am not absolutely convinced that this is homogeneous, particularly as the scrappy type is in fruit and is hairier than the rest of the material, has a less swollen petiolule and a broken apical bud.

33. Dysoxylum papillosum King

Dysoxylum papillosum King, J. As. Soc. Beng. 64, ii (1895) 50; Ridley, Fl. Malay Penins. 1 (1922) 397; Mabb. in Tree Fl. Malaya 4 (1989) 245.

Small tree to 6 m, flowering when a metre or so tall. Bark grey-green, inner bark orange. Leafy *twigs* 6–8 mm diam., tawny tomentose; apical buds with fist-shaped young leaves, densely tawny tomentose. *Leaves* to 45 cm long, 2- or 3-jugate, with apical spike to 15 mm or its scar; petiole 10–14 cm, ± angled, swollen weakly at base, like the rachis densely pilose, apical leaflets largest, 15–30 by 6–12 cm, elliptic to obovate, coriaceous, minutely rugulose in sicco, opposite to subopposite, bases gradually acute, ± symmetric, apices acuminate, glabrous adaxially, yellow-brown pilose abaxially especially on midrib and nerves, midrib stout, costae c. 10–15 on each side, obtuse arcuate, inarched only near margin and scarcely anastomosing, depressed adaxially and prominent abaxially when dry; petiolules 3–5 mm long, stout, densely tawny tomentose. *Spikes* 1.5–7.5 cm, supra-axillary on leafy or cicatrose twigs; rachis c. 4 mm diam., sericeous, woody. *Flowers* (only known in bud, description largely from King) sweetly scented. *Calyx* 4-toothed, densely tomentose without, broadly ovate, densely adpressed pubescent without, apices subacute. *Petals* 4, waxy. *Staminal tube* glabrous, margin 8-emarginate; anthers 8, oblong, exserted. *Disk* very small. *Style* pilose basally; stylehead discoid, dimpled. *Capsule* at least 3 cm long, 2 cm diam., pear-shaped, apiculate, densely tomentose, orange-red, 3- or 4-valved. *Seeds* 2–4; testa brown.

Distribution — Peninsular Thailand and *Malesia:* Malay Peninsula (Trengganu, Perak, Pahang, Selangor), Borneo (Sarawak).

Habitat — Rain forest, 300–550 m altitude.

Note — This is a very poorly known plant having the habit and facies of *Dysoxylum rugulosum* King and its allies with which it shares a spicate inflorescence and 4-merous flowers but lacks the stiletto-like apical buds typical of that group.

Section Cyrtochiton

Dysoxylum sect. *Cyrtochiton* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 9, 23.
Dysoxylum sect. *Dicrypta* Miq., op. cit. (1868) 9, 25.
Dysoxylum sect. *Siphodysoxylum* Pierre, Fl. For. Cochinch. 5 (1897) sub t. 351.

Apical buds with stiletto-like young leaves. Inflorescences usually spiciform. Flowers 4-merous. Seeds unitegmic, (?sarcotestal); cotyledons green.

34. Dysoxylum macrocarpum Blume

Dysoxylum macrocarpum Blume, Bijdr. (1825) 175; G. Don, Gen. Syst. 1 (1831) 683; M. Roem., Synops. Monogr. 1 (1846) 101; Miq., Fl. Ind. Bat. 1, 2 (1859) 537; Suppl. (1861) 196; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 23, incl. f. *sumatranum*; C.DC. in DC., Monogr. Phan. 1 (1878) 510, incl. var. *sumatranum* (Miq.) C.DC.; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 69; Backer, Schoolfl. Java (1911) 207; Koord., Exk. Fl. Java 2 (1912) 441; Atlas 1 (1913) t. 178; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 894; Backer & Bakh. f., Fl. Java 2 (1965) 123; Mabb. in Tree Fl. Malaya 4 (1989) 244. — [*Guarea macrocarpa* Blume apud Nees, Flora 7 (1824) 290, nom. nud.] — *Trichilia macrocarpa* (Blume) Spreng., Syst. Veg. 4, 2 (1827) 252, excl. syn.

Tree to 33 m; bole to 50 cm diam., with plank buttresses to 2 m tall and 1 m out. Bark smooth to longitudinally cracked, grey-green, faintly hooped and finely lenticellate; inner bark cream, flecked orange, fibrous within; wood pale yellow. Leafy *twigs* c. 7–13 mm diam., with wide pith, conspicuously cicatrose and lenticellate, yellowish when dry. Apical buds to 5 cm long. *Leaves* to 1 m, 3- or 4-jugate, subglabrous; petiole to 38 cm, swollen at base; rachis to 70 cm, markedly channelled adaxially. *Leaflets* to 30 by 10 cm, elliptic-ovate, alternate, drying ochreous, dull and thin when fresh, base ± cuneate, apex acuminate; costae 13–18 on each side, ascendant, looping indistinctly at margin, prominent abaxially, other venation obscure; petiolule to 6 mm, slightly swollen. *Thyrse* to 25 cm long, with spreading branches; flowers foetid. *Calyx* with irregular margin. *Petals* 4, finely hairy, creamy-white to orangeish. *Staminal tube* hairy within, margin ± truncate; anthers 8 (9), inserted within tube. *Disk* ± truncate. *Ovary* pubescent; style terete; stylehead discoid. *Infructescence* axis to 8 mm diam. with 1–3 fruits. *Capsule* to 10 cm diam., globose to pyriform, 8-locular, shallowly ridged, bright orange-red; pericarp with white latex; the mesocarp fleshy, orange-yellow. *Seeds* 1–4, 4.5 by 2.5 cm, orange-segment-shaped, with dark red-brown testa and thick pale orange raphe; cotyledons green.

Distribution — Thailand and *Malesia:* Sumatra, Malay Peninsula, Borneo, Java, Philippines, Celebes.

Habitat — Forests including riparian ones and those on limestone, to 1800 m altitude.

35. **Dysoxylum grande** Hiern

Dysoxylum grande Hiern in Hook. f., Fl. Brit. India 1 (1875) 547; C. DC in DC., Monogr. Phan. 1 (1878) 486; Brandis, Indian Trees (1906) 138; Kanj. et al., Fl. Assam 1, 2 (1936) 232; Mabb. in Tree Fl. Malaya 4 (1989) 244. — [*Guarea grandis* Wall., Cat. (1831/2) n. 4883, nom. nud.] — *Alliaria grandis* (Hiern) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Epicharis sp.: Kurz, Rep. Veg. Andam., ed. 1 (1868) App. B, iv.

Chisocheton grandiflorus auct. non (Kurz) Hiern: Kurz, Rep. Veg. Andam., ed. 2 (1870) 35, nom. nud. ('*Chisogeton*'); Hiern in Hook. f., Fl. Brit. India 1 (1875) 552, p.p.; C.DC. in DC., Monogr. Phan. 1 (1878) 534, p.p.; Anon., Andam. Nicob. Gaz. April 1900; Kloss, Andam. Nicob. (1903) 336; Brandis, Indian Trees (1906) 139, p.p.; C.E. Parkinson, For. Fl. Andam. (1923) 119.

Schizochiton grandiflorum Kurz, J. As. Soc. Beng. 41, ii (1872) 296; ibid. 44, ii (1875) 145, p.p.; For. Fl. Burma 1 (1877) 216, p.p.

Chisocheton costatus Hiern in Hook. f., Fl. Brit. India 1 (1875) 552; C.DC. in DC., Monogr. Phan. 1 (1878) 538; Brandis, Indian Trees (1906) 139.

Dysoxylum interruptum King, J. As. Soc. Beng. 64, ii (1895) 40; Ridley, Fl. Malay Penins. 1 (1922) 392.

Dysoxylum lukii Merr., Philipp. J. Sc. 23 (1923) 247; Lingn. Sc. J. 5 (1927) 103; Li, J. Arnold Arbor. 25 (1944) 302; How & Chen, Acta Phytotax. Sin. 4 (1955) 15, incl. var. *paucinervium* How & Chen; Anon., Fl. Hainan. 3 (1974) 64; Wu, Fl. Yunnan. 1 (1977) 250, t. 59 f. 1, 2; Hô, Ill. Fl. Vietnam 2, 1 (1992) 492. (Syn. nov.).

Dysoxylum lasiophyllum Baker f., J. Bot. Lond. 62, Suppl. (1924) 18.

Dysoxylum lobbii C.DC. var. *sumatranum* Baker f., op. cit. (1924) 17.

Dysoxylum corneri Hend., Gard. Bull. Str. Settl. 7 (1933) 92.

Tree to 39 m; bole to 70 cm diam., with plank buttresses to 2 m tall and 7.5 m out. Bark smooth to dippled, greyish brown, lenticellate; inner bark with cream and pinkish purple tangential bands; sapwood yellow brown. Leafy *twigs* c. 1.3–2 cm diam. with wide pith, often fulvous tomentellous; buds with long stiletto-like young leaves. *Leaves*

Fig. 17. *Dysoxylum grande* Hiern. Dehisced fruits. Kalimantan, Bukit Raya (*Nooteboom 4054*). Photograph H.P. Nooteboom, 1983.

to 1 m long, 6–9-jugate with apical stub or spike, one of the lateral leaflets often appearing terminal; petiole 10–15 cm, ± 3-angled, ± fulvous pubescent, base swollen. *Leaflets* 10–19 by 3.5–6 cm, oblong, the most proximal ones sometimes lanceolate, alternate to subopposite, brittle when dried, adaxial surface reddish brown in young leaves (Henderson, l.c.), rugulose with minute black glandular dots, glabrous except midrib and nerves sometimes yellow pubescent, abaxial surface gland-dotted, subglabrous to densely yellow-pubescent, margins subrevolute, bases rounded to shortly cuneate, apices acuminate to subcaudate, costae 23–25 on each side, subsquarrose, arching but not looping at margin, petiolules 5–9 mm, sulcate ± pubescent. *Thyrses* narrow, to 10 cm in females, to 30 cm with branches to 5 cm in males; axes angled, ± finely tomentose; bracts and bracteoles c. 0.5 mm, ephemeral. *Flowers* subsessile in cymules of 3 or 4, fragrant. *Calyx* c. 4.5 mm long (c. 2 mm in males), 7 mm diam. (5 mm in males), shortly cupular, ± pubescent without, margin 4-lobed. *Petals* 4, c. 9 mm long (7 mm in males), oblong, densely tomentose without, creamy yellow. *Staminal tube* minutely pubescent without, glabrous within, margin with 8 short, broadly triangular lobes; anthers 8, c. 1.2 mm long, oblong, included. *Disk* c. 1.3 mm tall, shortly cylindrical, often closely enveloping ovary, subglabrous without, densely long yellow pilose within. *Ovary* densely pilose, (3-) 4- (or 5-)locular, each locule (?) 1-ovulate; style 4-angled,

pubescent in proximal 1/2; stylehead cylindric-capitate, with basal annulus. *Infructescence* sparingly branched, with watery sticky latex. *Capsules* 1–4 on stout peduncles, 5–8 cm long, 7–11 cm diam., depressed globose, apically dimpled, orange, 3–5-sulcate. *Seeds* 1–4(–5), c. 2.5 cm long, with thick (?) sarcotesta; cotyledons green. — **Fig. 17.**

Distribution — Assam and southern China to Thailand and Hainan; *Malesia:* C and S Sumatra, Malay Peninsula, Borneo (Sarawak, Sabah and Nunukan Is.). See Note 2.

Habitat — Rain forest, especially hill forest, to 1400 m altitude.

Notes — 1. The specimens from Borneo are, in general, less pubescent than others.

2. *Dysoxylum verruculosum* Merr., Philipp. J. Sc., Bot. 8 (1913) 377; Enum. Philipp. Flow. Pl. 2 (1923) 366, from Leyte, Philippines (type: *Wenzel 28* - E, G) may also belong here.

36. **Dysoxylum pachyrhache** Merr.

Dysoxylum pachyrhache Merr., Univ. Calif. Publ. Bot. 15 (1929) 120; Kosterm., Reinwardtia 7 (1969) 436. — *Epicharis pachyrhachis* (Merr.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 170.

Tree to 20 m with clear bole to 10 m, 40 cm diam., sometimes with short buttresses. Bark smooth with large corky lenticels, chocolate brown, to superficially fissured and finely cracking; inner bark bright orange, granular; sapwood pale brown; heartwood brown. Crown with sparse branching, open. *Twigs* stout, angled with cicatrices, greyish brown with bright brown lenticels, densely tomentose when young. Leafy twigs c. 10–15 mm diam.; buds stiletto-like. *Leaves* to 1 m long in terminal spirals; 2–4-jugate with terminal spike or its scar, petiole 10–16 cm, terete to flattened adaxially, ± densely brown tomentose, weakly swollen at base, leaflets ± alternate, 12–25 by 7–12 cm, elliptic, ± coriaceous, glabrous except on midrib adaxially, softly pubescent abaxially, bases somewhat asymmetric, acute to rounded, costae 15–18 on each side, spreading, inarched but not looped at margin; petiolules 5–11 mm, drying dark brown, weakly swollen. *Thyrses* to 8 cm long, usually much less, subspiciform, with congested branchlets of subsessile weakly scented flowers, axillary, supra-axillary in axils of leaves or cicatrices; axis 4–6 mm diam., densely pubescent. *Calyx* 3–4 mm long, 5–6 mm diam., shallowly cupular, densely pubescent without, pale brown, margin irregularly 4-lobed. *Petals* 4, 8–9 by 3 mm, densely pubescent without, creamish. *Staminal tube* glabrous, margin ± crenate; anthers 8, c. 1.5 mm long, narrowly oblong, inserted within the tube. *Disk* c. 2–3 mm tall, glabrous, margin obscurely crenulate. *Ovary* 4-locular, densely adpressed pubescent; style adpressed pubescent at base; stylehead subcapitate c. 1 mm diam., with a basal annulus and impressions of stamens. *Capsule* solitary or in groups of 2 or 3, 5–8 cm long, c. 5–8 cm diam., subpyriform, glabrous when ripe, orange-red, stipe 1–1.5 cm, pericarp pale along sutures, to 1.5 cm thick, ochreous within. *Seeds* c. 2.5 cm long, orange-segment-shaped with creamy laticiferous (?) sarcotesta. — **Fig. 18, 19.**

Distribution — *Malesia:* Borneo.

Habitat — Rain forest, to 1600 m altitude.

Fig. 18. *Dysoxylum pachyrhache* Merr. Fruits. Sabah, Sepilok Forest Reserve (*Mabberley 1659*). Photograph D.J. Mabberley, May 1974.

Fig. 19. *Dysoxylum pachyrhache* Merr. a. Leafy shoot; b. detail of leaf; c. half flower; d. young inflorescences; e. infructescences (a: *Pennington 7954* and *Mabberley 1659*; b, c, e: *Chai S 31708*; d: *Mabberley 1659* and *Fidilis & Sumbing 88265*). Drawing R. Wise.

37. Dysoxylum oppositifolium F. Muell.

Dysoxylum oppositifolium F. Muell., Fragm. Phyt. Austral. 5 (1865/6) 177; C.DC. in DC., Monogr. Phan. 1 (1878) 501; F.M. Bailey, Queensl. Fl. 1 (1899) 229. — *Alliaria oppositifolia* (F. Muell.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Hartighsea sp.: Turcz., Bull. Soc. Imp. Nat. Mosc. 31 (1858) 412.

Dysoxylum latifolium auct. non Benth.: F. Muell., op. cit. (1865/6) 144.

Dysoxylum turczaninowii C.DC. in DC., Monogr. Phan. 1 (1878) 501; Fern.-Vill., Nov. App. (1880) 41; Vidal, Rev. Pl. Vasc. Filip. (1886) 81; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 365; Briq., Mém. Inst. Nat. Genev. 24 (1935) 49. — *Alliaria turczaninowii* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 109. (Syn. nov.).

?*Dysoxylum venosum* Merr., Philipp. J. Sc., Bot. 3 (1910) 185; Enum. Philipp. Flow. Pl. 2 (1923) 366.

Dysoxylum palawanense Merr., Philipp. J. Sc., Bot. 9 (1914) 538; Enum. Philipp. Flow. Pl. 2 (1923) 364. (Syn. nov.).

Dysoxylum wenzelii Merr., Philipp. J. Sc., Bot. 9 (1914) 367; Enum. Philipp. Flow. Pl. 2 (1923) 366; Briq., Mém. Inst. Nat. Genev. 24 (1935) 55; Elmer, Leafl. Philipp. Bot. 9 (1937) 3382. (Syn. nov.).

Dysoxylum ilocanum Merr., Philipp. J. Sc., Bot. 13 (1918) 298; Enum. Philipp. Flow. Pl. 2 (1923) 363. (Syn. nov.).

Dysoxylum capizense Merr., Philipp. J. Sc. 17 (1920) 268; Enum. Philipp. Flow. Pl. 2 (1923) 362. (Syn. nov.).

?*Dysoxylum ramosii* Merr., Philipp. J. Sc., Bot. 9 (1914) 539; Enum. Philipp. Flow. Pl. 2 (1923) 365.

Small tree to c. 10(–30) m; bole to 40 cm diam.; buttresses to 1.5 m tall. Bark flaking, yellow-brown; inner bark reddish. *Twigs* cicatrose. Leafy twigs c. 5–7 mm diam., pale brown in sicco, ± brownish puberulent; apical bud to 8 cm, stiletto-like. *Leaves* 15–45 cm, 3–6-jugate with apical scar, alternate to opposite; petiole 6–10 cm, drying yellowish, swollen at base, ± puberulent; rachis ± 4-angled, ± puberulent. *Leaflets* (the subapical the largest) (4–)8–17 by (2–)3.5–5.5 cm, oblong to elliptic, subcoriaceous, opposite or the more proximal sometimes alternate, subglabrous to pilose on midrib adaxially and on abaxial surface, particularly the venation, bases ± markedly asymmetric, rounded to acute, apices obtuse to shortly acuminate, costae c. 12–14 on each side, arcuate, obscurely looped, ± impressed adaxially, prominent abaxially; petiolules c. 3–6 mm, weakly swollen. *Inflorescences* 5–9 cm, racemose or thyrsoid, axillary or in axils of cicatroses; axes pubescent; branches to 8 mm, bearing 3-flowered cymules; pedicels c. 1 mm, articulated with very short pseudopedicels. *Calyx* c. 3 mm diam., puberulent without, margin 4-toothed, the teeth c. 1.5 mm long. *Petals* 4, c. 7 by 3–3.5 mm, oblong, obtuse, ± pubescent without, creamish. *Staminal tube* glabrous or very sparsely pubescent apically without, margin ± crenate; anthers 8, c. 1 mm long, ellipsoid, included. *Disk* c. 2 mm long and in diam., cupular, glabrous without, ± pubescent within, margin ± undulate. *Ovary* pubescent, 4-locular; style terete, pubescent in proximal half; stylehead discoid. *Capsule* c. 3 cm diam., apparently pyriform, 4-valved, veined, orange-black drying black. *Seeds* 2–4, c. 1 cm long, ellipsoid, with red (?) sarcotesta; cotyledons green .

Distribution — NE Australia and *Malesia:* Borneo (Sabah), Philippines (Luzon, Mindoro, Palawan, Panay, Leyte), New Guinea. Perhaps also belonging here are some sheets from the Lesser Sunda Islands: Sumba, one collection: *bb 8986* (BO); Flores, two collections: *Kostermans & Wirawan 796* (A, BO, L), *800* (AAU, BO, K, L).

Habitat — Rain forest, 300–500 m altitude.

38. Dysoxylum cyrtobotryum Miq.

Dysoxylum cyrtobotryum Miq., Fl. Ind. Bat., Suppl. 1 (1861) 196, 504; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 12, incl. var. *borneense* Miq. ('var. β forma *borneensis*'); C.DC. in DC., Monogr. Phan. 1 (1878) 526, incl. var. *borneense* Miq.; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320; Mabb. in Tree Fl. Malaya 4 (1989) 243. — *Alliaria cyrtobotrya* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 103.

Heynea multijuga Blume, Bijdr. (1825) 168; Spreng., Syst. Veg. 4, 2 (1827) 252; G. Don, Gen. Syst. 1 (1831) 685; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 235; Miq., Fl. Ind. Bat. 1, 2 (1859) 542. — *Alliaria multijuga* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 103. — *Dysoxylum multijugum* (Blume) Adelb., Blumea 6 (1948) 318, nom. illeg., non Arn. (1834); Backer & Bakh. f., Fl. Java 2 (1965) 123. — *Dysoxylum blumei* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 25; C.DC. in DC., Monogr. Phan. 1 (1878) 515; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 73, incl. var. *typicum* Koord. & Valeton ('*typica*') & var. *grandiflorum* Koord. & Valeton ('*grandiflora*'); Backer, Schoolfl. Java (1911) 208; Koord., Exk. Fl. Java 2 (1912) 442; Atlas (1913) t. 175, 176, incl. var. *grandiflorum* Koord. & Valeton. — [*Dysoxylum multifoliolatum* Li & Chen, Acta Phytotax. Sin. 22 (1984) 495, nom. nov. pro *Heynea multijuga*, nom. superfl. pro *Dysoxylum blumei*.]

Dysoxylum lobbii C.DC. in DC., Monogr. Phan. 1 (1878) 484. — *Alliaria lobbii* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 103.

Dysoxylum venulosum King, J. As. Soc. Beng. 64, ii (1895) 42; Ridley, Fl. Malay Penins. 1 (1922) 397; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 886.

Dysoxylum racemosum King, op. cit. (1895) 47, incl. var. *arboreum* King ('*arborea*').

Dysoxylum andamanicum King, op. cit. (1895) 49.

Dysoxylum biloculare Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 95.

Dysoxylum harmandianum Pierre, Fl. For. Cochinch. (1897) t. 345B. (Syn. nov.).

Dysoxylum tpongense Pierre, op. cit. (1897) t. 349B; Pellegr. in Fl. Indo-Chine 1 (1911) 749; Hô, Ill. Fl. Vietnam 2, 1 (1992) 493. (Syn. nov.).

Dysoxylum cochinchinense Pierre, op. cit. (1897) t. 350A, incl. var. *quocense* Pierre ('*quocensis*'); Pellegr. in Fl. Indo-Chine 1 (1911) 738, 748, incl. var. *harmandianum* (Pierre) Pellegr. & var. *quocense* Pierre; ibid., Suppl. 1 (1948) 701, incl. var. *quocense* Pierre; Hô, Ill. Fl. Vietnam 2, 1 (1992) 490. (Syn. nov.).

Amoora macrocarpa Merr., Philipp. Govt. Lab. Bur. Bull. 17 (1904) 24; Enum. Philipp. Flow. Pl. 2 (1923) 370.

Dysoxylum grandifolium Merr., Philipp. Govt. Lab. Bur. Bull. 29 (1905) 23; Enum. Philipp. Flow. Pl. 2 (1923) 363.

Dysoxylum turczaninowii auct. non C.DC.: Merr., Philipp. J. Sc. 1, Suppl. (1906) 72.

Dysoxylum heyneanum Valeton ex K. Heyne, Nutt. Pl. Ned. Indië, ed. 1 (1917) 55, nom. 'subnud.'.

Dysoxylum kinabaluense Merr., Philipp. J. Sc., Bot. 13 (1918) 75; J. Str. Br. Roy. As. Soc., spec. no. (1921) 320; Univ. Calif. Publ. Bot. 15 (1929) 120. (Syn. nov.).

Dysoxylum hexandrum Merr., Philipp. J. Sc., Bot. 13 (1918) 297; Enum. Philipp. Flow. Pl. 2 (1923) 363.

Dysoxylum panayense Merr., Philipp. J. Sc., Bot. 13 (1918) 299; Enum. Philipp. Flow. Pl. 2 (1923) 364.

Dysoxylum alternatum Ridley, Fl. Malay Penins. 1 (1922) 397.

Dysoxylum oblongifoliolum Quisumb. & Merr., Philipp. J. Sc. 37 (1928) 157.

[*Dysoxylum aurantiacum* Elmer, Leafl. Philipp. Bot. 9 (1937) 3357, nom. non rite publ., anglice.]

[*Dysoxylum bakeri* Elmer, op. cit. (1937) 3358, nom. non rite publ., anglice.]

[*Dysoxylum benguetense* Elmer, op. cit. (1937) 3360, nom. non rite publ., anglice.]

Tree to 30 m, but often much less; bole to 60 cm diam., sometimes fluted at base or with buttresses to 1 m tall, 30 cm out. Bark pale brownish grey, smooth and lenticellate to scaling, brittle; inner bark pale yellowish brown, sometimes mottled; sapwood pale yellow; heartwood red-brown with sour smell. *Twigs* angled and cicatrose, often dull purple-tinged when young, leafy ones 5–7 mm diam. Apical buds stiletto-like. *Leaves*

to 67 cm long, ± imparipinnate with a scar next to the 'terminal' leaflet, 4- or 5(–6)-jugate; petiole c. 15–22 cm, 3–5 mm diam., flattened adaxially, glabrescent; rachis 2–3 mm diam., glabrescent. *Leaflets* 18–23 by 6–12 cm, oblong-ovate, sometimes narrowly so, ± glabrous, sometimes sparsely hairy on venation abaxially, leathery, subsessile, base ± asymmetric, acute to subcuneate, apices acute to (long-)acuminate, costae 7–13 on each side, squarrose at origin, looping but scarcely joining at margin, sometimes yellowish in sicco; petiolules 0–5 mm. *Inflorescences* 8–25 cm long, spicate to scarcely branched, squarrose, axillary to ramiflorous, axes sparsely hairy, subsessile cymules 1–7-flowered; bracts c. 1 mm long, subtriangular. *Flowers* fragrant (honeysuckle, Mabberley). Bracteoles minute. *Calyx* c. 4 mm long, apically cupular, basally a pseudopedicel, ± puberulent without, olive-green, margin 4- (or 5-)toothed, valvate. *Petals* 4 (5), c. 5–7 by 2 mm, elliptic-oblong, valvate to apically imbricate, puberulent without, yellowish, sometimes pinkish apically. *Staminal tube* glabrous, off white, weakly hairy without, margin 8- (or 10-) toothed; anthers (6–)8(–10), c. 1.5 mm long, elliptic-ovate, yellow, ± included. *Disk* c. 1–1.5 mm tall, not exceeding ovary, glabrous, margin irregularly c. 8–12-toothed. *Ovary* (2- or) 3-locular, hairy, each locule with 2 collateral ovules; style cylindical, furrowed, hairy, pale green; stylehead subcapitate, with basal annulus, white to pale orange. *Capsule* c. 4 cm long, 5 cm diam., globose to fig-shaped, often veiny or wrinkled, orange-red (black in sicco), dehiscent; the pericarp with white latex. *Seeds* 1–6, c. 25–35 mm long, 15–20 mm across, elliptic to suboblong, shiny brown-orange, (?) sarcotestal.

Distribution — SE Asia to *Malesia:* Nicobars, Andamans, Sumatra, Malay Peninsula, Borneo, Java, Philippines, Lesser Sunda Islands (Bali; a sterile collection from Flores, *bb 11377*, may also belong here).

Habitat & Ecology — Primary and secondary forest, including that on limestone and in peatswamps, to 1800 m altitude. A very common tree.

Note — I am not altogether convinced that this is homogeneous in that upland plants from Borneo with smaller leaves and thicker leaflets seem to be distinct though apparently linked by intermediate specimens to the main corpus of material. To the east, the plant is replaced by *Dysoxylum latifolium* Benth. and to the west by *D. pallens* Hiern and allied taxa which may be conspecific with *D. cyrtobotryum*; indeed, material from N Sumatra, e.g. *de Wilde et al. 19963* in L, very closely resembles such plants. There are, in addition, from the Malay Peninsula 2 m tall treelets known so far only in fruit and similar in facies to *Dysoxylum sp. 3: FRI 20143* (K) from Pahang and *Chew 71* (SING) from Trengganu.

Galls — Specimens from Borneo often have fasciated proliferating inflorescences.

39. **Dysoxylum latifolium** Benth.

Dysoxylum latifolium Benth., Fl. Austral. 1 (1863) 381; F. Muell., Fragm. Phyt. Austral. 9 (1875) 61; C.DC. in DC., Monogr. Phan. 1 (1878) 490; F.M. Bailey, Queensl. Fl. 2 (1899) 228. — *Alliaria latifolia* (Benth.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

[*Dysoxylum distantinerve* F. Muell., l.c., nom. in syn.]

Dysoxylum confertiflorum Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 304. (Syn. nov.).

Tree to 30 m; bole to 50 cm diam., fluted. Bark smooth to finely fissured and scaling; inner bark orange and fawn mottled with little or no latex; sapwood straw; heartwood reddish. Leafy *twigs* 5–7 mm diam., subglabrous; apical buds stiletto-like. *Leaves* 20–30 cm, 3- or 4-jugate, with terminal spike or its scar, dark glossy green adaxially, alternate, rarely subopposite; petiole 6–10 cm, ± angled, subglabrous. *Leaflets* 8–15 by 5–9 cm, ovate to oblong, chartaceous, glabrous, or veins puberulent, opposite to alternate, bases asymmetric, acute to rounded, apices obtuse to shortly acuminate, costae 8–12 on each side, pale and prominent abaxially in sicco, arcuate, obscure near margin, secondary venation obscure; petiolules 5–8 mm, swollen, drying blackish. *Thyrses* axillary to supra-axillary, 3–11 cm, spiciform; axis pubescent, bearing cymules of 1–3 weakly scented flowers rectangular in bud; bracts c. 0.5 mm, triangular, pubescent, caducous; pedicels c. 1.5 mm, pubescent, articulated with short pseudopedicels. *Calyx* c. 1.5 mm long, 3–4 mm diam., shallowly cupular, pubescent without, margin 4-toothed. *Petals* 4, 5–6 by c. 2 mm, oblong, puberulous without, white. *Staminal tube* pubescent without, glabrous within, white, margin crenulate to ± dentate; anthers 8, c. 1 mm long, included. *Disk* 0.5–1 mm, glabrous, margin undulate. *Ovary* densely pubescent, 4-locular; style pubescent in proximal 2/3; stylehead shortly cylindrical with basal annulus. *Capsule* c. 5 cm long, 4 cm diam., pyriform, ± veined, orange-brown when ripe, erect, solitary or in groups up to 4, pericarp sometimes with weak latex. *Seeds* 1–3, c. 2 cm long, 1 cm wide, flattened ellipsoid; the sarcotesta red; cotyledons collateral, green.

Distribution — Solomon Islands, northern Australia; *Malesia:* New Guinea; a sterile sheet from Ternate (*Beguin 5*) may also belong here.

Habitat — Rain forest and semi-deciduous thicket (Port Moresby region), to 1200 m altitude. Frequently reported as a common canopy tree.

Vernacular names — Herrip (Manikiong), ubizera (Garaina).

Note — This is the Papuasian counterpart of *Dysoxylum cyrtobotryum* Miq.

40. **Dysoxylum kaniense** Harms

Dysoxylum kaniense Harms, Bot. Jahrb. 72 (1942) 194.
?*Dysoxylum pachystachyum* Harms, op. cit. (1942) 197.

Tree to 24 m; bole to 50 cm diam. with buttresses to 60 cm tall and out, 7 cm wide. Bark smooth, lenticellate, to finely fissured, dark brown; inner bark yellowish and reddish brown mottled; sapwood light brown; heartwood reddish brown. Leafy *twigs* 7–10 mm diam., lenticellate, apical buds stiletto-shaped. *Leaves* 30–45 cm, subglabrous, 4–6-jugate with apical stub or scar; petiole 9–14 cm, flattened adaxially, swollen basally; rachis angled or almost winged. *Leaflets* 12–26 by 4–11 cm, ovate to oblong, minutely rugulose, bases asymmetric, attenuate to obtuse, apices acuminate, midrib prominent on both sides, costae 12–15(–18) on each side, spreading, not obviously looped at margin, ± sunken adaxially and prominent abaxially in sicco; petiolules c. 6–12(–15) mm, weakly swollen, drying blackish. *Thyrses* spiciform, 3–13 cm, axillary to supra-axillary, ± squarrose; axis puberulous, 3–4 mm diam., bearing scattered congest-

ed cymules of 1–5 flowers; bracts c. 0.5 mm, triangular, hirsute, caducous; pedicels c. 1 mm, pubescent. *Calyx* c. 2.5 mm long and in diam., with very short pseudopedicel, cupular, puberulous without, margin subentire to 4-dentate, the teeth obtuse to acute. *Petals* 4, at least 4 mm long, acute, valvate, densely short-pubescent without, white. *Staminal tube* ± weakly puberulous apically without, glabrous within, margin subtruncate to crenulate; anthers 8, c. 1 mm long, oblong, glabrous, ± included. *Disk* c. 0–5 mm tall, ± pubescent within, margin shallowly lobed, ciliate. *Ovary* pubescent, 4-locular; style pubescent in proximal 2/3; stylehead subconical-clavate. *Capsule* solitary, to 10 cm long, 8 cm diam., pyriform but often asymmetric by abortion, apically dimpled, ribbed, scurfy, ochre, drying brown. *Seeds* at least 2, ?sarcotestal.

Distribution — Solomon Islands (Santa Cruz Group, Ulawa); *Malesia:* New Guinea.

Habitat — Rain forest to 700 m altitude.

Vernacular names — Herrib (Manikiong), kamungolo (Mooi), sjaf (Berik).

Note — The Solomon Islands collections in particular approach the New Guinea material referred to *Dysoxylum oppositifolium*, with which it shares a vernacular name. Except for the type, I have seen no flowering material from New Guinea, and that from the Solomons is immature, having a short tube and exserted anthers like the immature flowers described as the type of *D. pachystachyum*.

41. **Dysoxylum enantiophyllum** Harms

Dysoxylum enantiophyllum Harms, Bot. Jahrb. 72 (1942) 192.

Treelet 2–8 m; bole to 10 cm diam. Bark brown; inner bark yellowish; wood straw. Leafy *twigs* c. 4–6 mm diam.; buds with long stiletto-like young leaves, finely tomentellous. *Leaves* 10–25 cm, 2–4-jugate, ± paripinnate with apical spike or its scar, puberulous or subglabrous, opposite or rarely subopposite; petiole 5–10 cm, angled, swollen at base. *Leaflets* 7–15 by 3–6 cm, oblong to obovate-oblong, finely rugulose, bases acute, apices acuminate, costae 7–10 on each side, ascending, not clearly looped at margin, tertiary venation obscure; petiolules c. 4–6 mm, sulcate, weakly swollen. *Thyrses* (Harms, l.c.) 3–10 cm, axillary, racemiform bearing glomerules of 1 to a few flowers; axes minutely puberulous. *Calyx* 2–2.5 mm long, puberulous, margin 4-toothed, the teeth acute. *Petals* 4, c. 4–5 mm long, lanceolate-ligulate, appressed pubescent, drying pale. *Staminal tube* adpressed puberulous without, glabrous within, margin crenulate; anthers 6–8, included. *Disk* short, glabrous. *Ovary* adpressed pubescent; style adpressed pubescent, stylehead capitate. *Capsule* c. 4 cm long, 3 cm diam., pyriform, finely pubescent when young, orange when ripe, valves 3 or 4. *Seeds* 3 or 4, c. 1 cm long, covered with red (?) sarcotesta.

Distribution — *Malesia:* New Guinea.

Habitat — Lowland, hill and montane, including secondary and mossy rain forest, to 2900 m altitude.

Notes — 1. One of the specimens cited by Harms was identified as *Dysoxylum schultzii* C.DC. by Kostermans [Reinwardtia 7 (1969) 435].

2. The description of the flowers is taken from Harms.

3. The plant is the New Guinea equivalent of *Dysoxylum rugulosum* King but has opposite leaves.

42. Dysoxylum rugulosum King

Dysoxylum rugulosum King, J. As. Soc. Beng. 64, ii (1895) 49; Ridley, Fl. Malay Penins. 1 (1922) 397; Mabb. in Tree Fl. Malaya 4 (1989) 245.
Dysoxylum undulatum Hend., Gard. Bull. Str. Setl. 7 (1933) 90.
Dysoxylum fulvum Airy Shaw, Kew Bull. (1940) 255.

Small tree to 20 m, flowering when a sapling; bole to 20 cm diam. Bark smooth, brown, to finely fissured and scaling; inner bark yellow-brown, mottled; sapwood cream. *Branches* striate, cicatrose. Leafy twigs 4–6 mm diam., fulvous tomentellous when young; apical bud stiletto-shaped. *Leaves* 20–40 cm, (1) 2–4 (5)-jugate, with a terminal pair of leaflets with a scar between them or one leaflet and a spike or its scar; petiole 6–15 cm, ± finely puberulous, flattened adaxially, conspicuously swollen at base; rachis angled or weakly winged. *Leaflets* 10–27 by 2.5–8 cm, the most distal the largest, oblong-lanceolate, chartaceous to subcoriaceous, rugulose, minutely black gland-dotted, alternate to sub-opposite, bases acute, attenuate, apices abruptly acuminate, costae 8–14 on each side, sometimes with domatia in axils, acute to obtuse, arcuate, prominent abaxially, secondary venation obscure; petiolules 4–10 mm, swollen, blackish in sicco. *Thyrses* 1–8 cm, spike-like, supra-axillary; rachis c. 2–3 mm diam., puberulous, bearing congested cymules of 3 or 4 sweetly scented (fide Richards) flowers; bracts c. 1 mm, triangular. *Calyx* c. 2 mm long, 5 mm diam., very shallowly cupular, puberulous without, shortly 4-toothed. *Petals* 4, c. 8 by 3 mm, elliptic, puberulous without, yellowish, valvate. *Staminal tube* ± 4-angled, glabrous or sparsely puberulous on angles without, margin crenate to (7–)8(–9)-toothed, the teeth emarginate; anthers (7) 8 (9), c. 1 mm long, elliptic, included. *Disk* c. 2 mm long and in diam., fleshy, glabrous or ± pubescent within, margin erose to c. 8-toothed. *Ovary* pubescent, 4-locular; style puberulent in proximal half; stylehead discoid with basal annulus. *Capsule* solitary or paired, 3–5 cm long, c. 2–2.5 cm diam., deeply 3- or 4-lobed, glabrous and orange when mature, drying blackish, veined. *Seeds* black (Henderson, l.c.).

Distribution — *Malesia:* Sumatra (Bengkulu, sterile, Jambi), Malay Peninsula (Perak, Pahang, Selangor, Malacca), Borneo (Sarawak, Sabah, E Kalimantan).

Habitat & Ecology — Lowland and hill rain forest to 2050 m altitude. Plants are not infrequently attacked resulting in leaf damage like that recorded for *Dysoxylum brachybotrys* while Henderson (l.c.) notes that the ovaries are sometimes abnormally large through their being occupied by larvae.

Note — *Dysoxylum brachybotrys* may be merely a rather distinct form of this species. Other rather distinctive forms, possibly worth recognizing, but as yet little known, are represented by a number of collections from the Bornean uplands: Sarawak, Kalabit Highlands, 1000 m, *Nooteboom & Chai 1652* (L); Lubok Antu, Bukit Langak, 1300 m, *Chai S 33824* (L); Mt Mulu, 1500 m, *Anderson S 4599* (L); Upper Plieran, *S 3430* (FHO); Sabah, Mt Kinabalu, Mesilau R., 1600 m, *Chew & Corner RSNB 4250* (L) and *SAN 60791* (K).

43. Dysoxylum brachybotrys Merr.

Dysoxylum brachybotrys Merr., Philipp. J. Sc. 26 (1925) 461.
Dysoxylum brachystachys Ridley, Bull. Misc. Info. Kew (1930) 364.

Tree to 20 m, flowering when only a few m tall; bole to 15 cm diam. Bark rugulose; inner bark bright orange; wood straw. Leafy *twigs* c. 5 mm diam.; apical buds stiletto-like, puberulent. *Leaves* 20–30 cm long, glabrous, 2- or 3-jugate with apical pair of leaflets and spike to 8 mm or its scar between them; petiole c. 4–7 cm, swollen at base. *Leaflets* 8–18 by 3–7 cm, oblong to narrowly elliptic or ovate, chartaceous to subcoriaceous, surface minutely verruculose in sicco, paler abaxially in sicco, alternate to subopposite, bases acute, attenuate, apices cuspidate-acuminate with acumen to 2 cm, midrib prominent on both sides, costae 7–9 on each side, some at least opposite, arcuate, prominulous abaxially, obscurely looped at extreme margin, domatia in axils of most, secondary venation obscure; petiolule 5–8 mm, rather swollen, especially apical ones, drying blackish. *Thyrses* spiciform, to 5 cm long, in axils of leaves or cicatrices; axis c. 2–3 mm diam., puberulous, bearing congested cymules of subsessile flowers (n.v.). *Calyx* cupular, puberulous without, yellowish, margin 4-lobed. *Petals* 4, 6 by 2.5 mm, ± puberulous without, cream. *Staminal tube* glabrous, truncate; anthers 8, 1 mm long. *Disk* c. 1 mm tall. *Ovary* puberulous; style ± puberulous; stylehead orbicular. *Capsule* solitary, 3.5 cm long and in diam., pyriform, deeply 3- or 4-lobed, glabrous, veined, bright red when mature, drying black. *Seeds* 3 or 4, 2 cm long, 1.5 cm diam., flattened ellipsoid, green; hilum c. 1 cm long; cotyledons oblique.

Distribution — *Malesia:* Borneo (Sarawak and Sampit area), Philippines (Mindanao).

Habitat & Ecology — Rain forest to 1000 m altitude, common on ridges as at Mt Lundu, Sarawak (fide Pennington). Fruit pecked by birds (fide Pennington).

Note — Several specimens have marked perforations, usually running along veins of expanded leaves, due to (?) insects. The domatia are characteristic, but the species is very closely related to and perhaps not distinct from *Dysoxylum rugulosum* King.

44. Dysoxylum flavescens Hiern

Dysoxylum flavescens Hiern in Hook. f., Fl. Brit. India 1 (1875) 549; C.DC. in DC., Monogr. Phan. 1 (1878) 494; King, J. As. Soc. Beng. 64, ii (1895) 49; Ridley, Fl. Malay Penins. 1 (1922) 396; Mabb. in Tree Fl. Malaya 4 (1989) 244.
Hartighsea ramiflora Griff., Notul. 4 (1854) 501, p.p.
Dysoxylum griffithii Hiern in Hook. f., Fl. Brit. India 1 (1875) 549; C.DC. in DC., Monogr. Phan. 1 (1878) 497; King, J. As. Soc. Beng. 64, ii (1895) 46.
Dysoxylum acutangulum auct. non Miq.: Corner, Seeds Dicots 1 (1976) 189.

Tree to 33 m tall; bole to 70 cm diam.; buttresses to 1 m tall and 60 cm out. Bark superficially cracked, brown with star-shaped pustulate lenticels; inner bark pinkish; sapwood straw; heartwood pale reddish brown. Leafy *twigs* c. 7 mm diam.; apical bud stiletto-like. *Leaves* to 48 cm long, spirally arranged, 3–5-jugate, glabrous; petiole 8–13 cm, flattened adaxially, swollen and often blackish (when dried) at base. *Leaflets* 7.5–13 by 3.4–4.7 cm, narrowly elliptic-ovate, subcoriaceous, subopposite, often shiny adaxially, bases rounded to subcuneate, ± asymmetric, apices acuminate, costae

c. 13–19 on each side, indistinct, subsquarrose and spreading, inarched only near margin but not looped; petiolules 3–4(–9) mm, blackened at base when dried. *Thyrses* 5–10 cm, subspiciform with fascicles of 1 or a few sessile flowers; bracts c. 0.5 mm, triangular. *Calyx* c. 2.5 mm diam., almost flat, puberulent without, confluent with pseudopedicel c. 1 mm long, margin deeply 4-lobed. *Petals* 4, c. 7 mm long, creamy yellow, subglabrous to puberulent without. *Staminal tube* thick, tough, weakly pilose distally, margin crenate; anthers 8, ovate, included. *Disk* shortly cupuliform, glabrous, fleshy. *Ovary* pubescent, 4-locular, each locule with 2 collateral ovules; style pubescent in proximal half; stylehead discoid. *Capsule* at least 4 cm diam., depressed-globose, weakly stipitate, reddish orange. *Seed* (Corner, l.c.) brown to black with small arilloid hilum on one side, seedcoat apparently largely pachychalazal; cotyledons green.

Distribution — *Malesia:* Sumatra (N & C), Malay Peninsula (Selangor southwards), Borneo.

Habitat — Rain forest, to 1700 m altitude.

Note — This and the following two species are closely allied large trees of commercial importance.

45. **Dysoxylum acutangulum** Miq.

Dysoxylum acutangulum Miq., Fl. Ind. Bat., Suppl (1861) 196, 503; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 26; C.DC. in DC., Monogr. Phan. 1 (1878) 525; King, J. As. Soc. Beng. 64, ii (1895) 41; Valeton, Ic. Bogor. 1 (1897) t. 11; Koord., Atlas 1 (1913) t. 169; Ridley, Fl. Malay Penins. 1 (1922) 393; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 884; K.Heyne, Nutt. Pl. Indon., ed. 3 (1950) 892; Kosterm., Reinwardtia 7 (1969) 435, p.p.; Mabb. in Tree Fl. Malaya 4 (1989) 240, f. 6B. — *Alliaria acutangula* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum schultzii C.DC. in DC., Monogr. Phan. 1 (1878) 502 ('*schulzii*'); Harms, Bot. Jahrb. 72 (1942) 199; Kosterm., Reinwardtia 7 (1969) 435. — *Alliaria schultzii* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Dysoxylum foveolatum Radlk., Sitzungsber. Math.-Phys. Kl. Kön. Bayer. Akad. Wiss. München 9 (1879) 598.

Tree to 47 m tall; bole to 140 cm diam., fluted and clear to 18 m; buttresses to 3 m tall and 2 m out. Bark smooth, yellowish, with conspicuous lenticels, becoming irregularly cracked and shedding large scales; inner bark yellowish or orangish fawn, somewhat speckled and with groups of conspicuously thickened cells; wood orange-brown, hard. Leafy *twigs* c. 6 mm diam. with conspicuous cicatrices and lenticels; apical buds stiletto-like with minute fulvous tomentum. *Leaves* 15–30(–40) cm, 2–6(–7)-jugate, paripinnate with minute apical spike or its scar, glabrous to minutely puberulous, ± decussate; petiole 8–11 cm long, 3–4 mm diam., adaxially grooved and angled when dried, base somewhat swollen; rachis grooved and angled when dried. Largest *leaflets* the most distal, 9–15 by 5–6.5 cm, elliptic, coriaceous, in life minutely pellucid-punctate (Valeton, l.c.), minutely rugulose when dried, subopposite, bases acute, ± asymmetric, apices acute to acuminate, costae c. 14–16 on each side, rather obscure, spreading, sometimes with domatia in their axils; petiolules 5–8(–10) mm, scarcely swollen. *Thyrses* 3–8 cm, narrow, axillary to subramiflorous; axes pubescent, bearing fascicles of 1 to a few hyacinth-scented (Valeton, l.c.) flowers; bracts c. 0.5 mm, densely pubes-

cent; pedicels 0–1 mm. *Calyx* c. 2.5 mm diam., very shallowly crateriform, confluent with pseudopedicel c. 1 mm long, sparsely shortly pubescent without, margin ± 4-lobed. *Petals* 4, c. 12–13 mm long, oblong, ± puberulous on both sides, yellow or creamy yellow, apices acute. *Staminal tube* sometimes sparsely pubescent without, glabrous within, margin crenulate; anthers 8(–10), c. 1 mm long, ovate to elliptic, weakly exserted. *Disk* c. 1.5 mm tall, shallowly cupuliform, fleshy, glabrous or sometimes pubescent within, red. *Ovary* densely pubescent (3- or) 4-locular, each locule with 2 collateral ovules; style pubescent in proximal half; stylehead subdiscoid. *Capsule* 5–8 cm diam., subglobose to pyriform, (3- or) 4-valved, glabrous, orange; pericarp to 1 cm thick, heavily veined when old, latex white. *Seeds* (3) 4, sometimes some aborted, c. 2 cm long, ellipsoid, black with small orange arilloid hilum on one side; cotyledons green.

a. subsp. **acutangulum**

Dysoxylum acutangulum Miq. — *Alliaria acutangula* (Miq.) Kuntze.

Tree to 47 m. Leaflets 2–4 on each side of midrib, elliptic, without domatia.

Distribution — ?Peninsular Thailand; *Malesia:* Sumatra (incl. Riau-Lingga Archipelago, Billiton, Bangka), Malay Peninsula, Borneo (W Sarawak, Kalimantan), Philippines (Palawan).

Habitat — Rain forest, to 1000 m altitude.

Vernacular names — Ambalo, ambalun, membalo (Sumatra, Bangka).

Uses — Membalo is perhaps traditionally the most important native meliaceous timber tree and was formerly much exported from Bangka to Java. The wood of the bole and particularly the buttresses is beautifully marked but difficult to work (Burkill, l.c.): it has been largely used for furniture but also beams, cartwheels and coffins. The seeds are said to be poisonous and contain dysoxylum acid.

b. subsp. **foveolatum** (Radlk.) Mabb.

Dysoxylum acutangulum Miq. subsp. *foveolatum* (Radlk.) Mabb., Blumea 38 (1994) 303. — *Dysoxylum schultzii* C.DC. — *Alliaria schultzii* (C.DC.) Kuntze — *Dysoxylum foveolatum* Radlk.

Tree to 37 m tall. Leaflets 4–6(–7) on each side of midrib, narrowly elliptic, usually with domatia.

Distribution — Australia (Northern Territory, Queensland), Solomon Islands (San Cristobal); *Malesia:* S and W Sumatra, W Java, Lesser Sunda Islands (Flores, Timor), Moluccas (Tanimbar Islands, Aru Islands), New Guinea.

Habitat — Rain forest, to 950 m altitude, a frequent canopy tree in New Guinea and recorded from gullies in tropical Australia.

Vernacular name — Ngersaweran (Aru Is.).

Note — *Laumonier 6098* from Mt Korang, W Sumatra has the narrow leaflets typical of subsp. *foveolatum* but lacks domatia. Some New Guinea specimens, in the absence of locality data would be difficult to place as they are almost intermediate between this and subsp. *acutangulum*.

46. Dysoxylum carolinae Mabb.

Dysoxylum carolinae Mabb., Blumea 38 (1994) 305, f. 3.
'*Dysoxylon sp.* (*Sing. FN 32212*)': Corner, Seeds Dicots 1 (1976) 189.
Dysoxylum sp. 1: Mabb. in Tree Fl. Malaya 4 (1989) 246.

Tree to 45 m; bole to 110 cm diam., fluted; buttresses to 3 m tall and out, concave. Bark smooth with large lenticels to 6 mm long, to flaking, grey to dark brown; inner bark white with coarse orange flecks and strong smell of stewing vegetables (fide Kochummen); wood yellow brown. All young parts fulvous-tomentellous. Leafy *twigs* 4–8 mm diam., angled, greyish, held erect. Apical bud spike-like, plump. *Leaves* c. 10–18 cm long, paripinnate, 3–5-jugate with small apical scar; petiole c. 5–8 cm; rachis ± finely winged. *Leaflets* (subapical the largest) to c. 7 by 3 cm, oblong, leathery, shiny and glabrous adaxially, surface minutely rugulose abaxially, midrib sericeous and with domatia abaxially, strongly keeled in vivo, base rounded to weakly oblique, apex acuminate; costae and intercostae not distinct from one another, c. 20 on each side, looped at margin. *Thyrse* to c. 10 cm, weakly branched. *Flowers* faintly citronella-scented. *Calyx* c. 5 mm diam., 1.5 mm long, margin 4-lobed. *Petals* 4, c. 6 mm long, puberulous without. *Staminal tube* narrowed at apex, puberulous without, becoming yellow; anthers 8, c. 0.8 mm long, ovate, weakly exserted. *Disk* c. 1 mm, shallowly cupular, yellow, margin truncate. *Ovary* 4-locular, each locule with 1 ovule. *Infructescences* in axils of fallen leaves. *Capsule* to 5 cm long and 7 cm diam., depressed globose, splitting into 4, orange-red. *Seeds* 1 or 2 (3), c. 3 cm long, 2.5 cm across, black with orange sarcotesta; cotyledons green. — **Fig. 20.**

Distribution — Vietnam (one collection) and *Malesia:* Sumatra, Malay Peninsula (extinct in Singapore, the only known tree, at MacRitchie Reservoir, having been felled during the Japanese occupation), Borneo (Brunei, Sabah). Collected in flower only once (the type).

Habitat & Ecology — Lowland and hill forests, to 1100 m altitude. Fruits eaten by monkeys (Corner, l.c.).

Vernacular name — Embalau burung (Sumatra).

INSUFFICIENTLY KNOWN SPECIES

47. Dysoxylum sp. 1 (Sect. ?)

Dysoxylum revolutum Elmer, Leafl. Philipp. Bot. 9 (1937) 3373, nom. non rite publ. (anglice). — *Dysoxylum alternifolium* Elmer, op. cit. (1937) 3352, nom. non rite publ. (anglice).

Apparently a small tree, somewhat resembling *Dysoxylum brachybotrys* Merr. but the leaflets do not form a terminal pair. It is known to me only in fruit, though Elmer described the flowers.

Distribution — Philippines: Leyte - *Elmer 7250* (A, BM, BO, BP, FI, G, K, L, NY, P, U, UC); Palawan - *Elmer 12826* (A, BK, BM, BO, BP, G, K, L, NY, P, U, UC), *13230* (A, BM, BP, FI, G, K, L, NY, U, UC, Z); possibly Mindanao - *Merrill 11632* (A, BK, L).

Fig. 20. *Dysoxylum carolinae* Mabb. a. Leafy shoot; b. inflorescence; c. half flower; d. infructescences; e. detail leaf with domatia (a: *Mabberley & Pannell 1989*; b, c: *Symington FD 49827*; d. *Brillet 14*; e. *Putan SAN 40680*). Drawing R. Wise.

48. Dysoxylum sp. 2 (Sect. *Cyrtochiton*)

?*Dysoxylum ramosii* Merr., Philipp. J. Sc., Bot. 9 (1914) 539; Enum. Philipp. Flow. Pl. 2 (1923) 365.

A treelet 1–2 m tall with 6-jugate leaves with very narrow leaflets, otherwise resembling a very hairy form of *Dysoxylum oppositifolium* F. Muell. in fruit. Flowers unknown.

Distribution — Philippines: Luzon, Sierra Madre Mts - *PNH 78064* (L), *78289* (L).

49. Dysoxylum sp. 3 (Sect. *Cyrtochiton*)

A treelet to c. 3 m, of weeping habit, with grey twigs and 2- or 3-jugate leaves with narrow glabrous leaflets and solitary orange fruits reminiscent of those of *Dysoxylum cyrtobotryum*, containing 4 black seeds with orange arils. Flowers unknown.

Distribution — Borneo: Sabah, Sandakan - *Mabberley 1694* (FHO, L), *SAN 40954* (K, SING), *SAN 82862* (FHO, SAN), *SAN 87734* (BO, FHO, KEP, SING); Kinabatangan - *SAN 51910* (L); Tawau - *SAN 24476* (L); sine loc. - *Wood 69b* (A); Philippines: Mindanao, Zamboanga Dist. - *BS 37095* (L).

50. Dysoxylum sp. 4 (Sect. *Cyrtochiton*)

A 'medium-sized' tree with densely pubescent 1-jugate leaves and axillary fascicles of immature fruits.

Distribution — New Guinea (West Sepik Province, Ossima: *NGF 39206*).

ANTHOCARAPA

Anthocarapa Pierre, Fl. For. Cochinch. 5 (1897) sub t. 343; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 166; T.D. Penn., Blumea 22 (1975) 500, t. 13b, c; Mabb., Blumea 31 (1985) 132; in Fl. Nouv.-Caléd. et Dép. 15 (1988) 70.

Amoora Roxb. sect. *Pseudoguarea* C.DC. in DC., Monogr. Phan. 1 (1878) 590, p. maj. p.

Trees. *Indumentum* of simple hairs. *Leaves* paripinnate. *Flowers* unisexual (trees dioecious or monoecious), in axillary or supra-axillary thyrses. *Calyx* 4- or 5-lobed to the middle or more deeply. *Petals* (4) 5, free, imbricate, at least at apices. *Staminal tube* ± urceolate, margin crenulate; anthers 10, glabrous, inserted within tube throat, partly exserted. *Disk* obscure, thick, fleshy, annular or patelliform in male flowers, small, annular at the base of ovary in female flowers. *Ovary* (2-) 3- (or 4-)locular, locules uniovulate, placentation axile; stylehead discoid. *Fruit* a 2-, 3- (or 4-)valved capsule, (tardily) dehiscent loculicidally. *Seed* with non-vascularized sarcotesta; embryo with thick collateral cotyledons; radicle superior, included.

Distribution — 1 or possibly 2 (see below) species from Philippines to New Caledonia.

Note — Although *Anthocarapa* would not be confused with *Xylocarpus* in the field as their ecology is completely different, or in fruit, flowering material may be confused in the herbarium, which is probably why Pierre named the genus *Anthocarapa*, *Xylo-*

Fig. 21. *Anthocarapa nitidula* (Benth.) T.D. Penn. ex Mabb. a. Habit; b. leaf bud; c. half flower; d. fruits; e. fruit, transverse section; f. seed (a: *Versteegh BW 7487* and *Verheijen 3236*; b, e: *Verheijen 3236*; d: *Versteegh BW 7487*; e, f: *Gafui BSIP 14898*). Drawing R. van Crevel.

carpus sometimes being included in the genus *Carapa* Aubl. from tropical America and Africa. In *Xylocarpus*, though, there are always 4 glabrous petals, 8 anthers and 8 staminal tube lobes, and a 4- (or 5-)lobed ovary, each locule with 3 or 4(–6) ovules. The distinction from *Dysoxylum* is very slight (see generic key), such that the genus is scarcely separable, Harms having already described material of *A. nitidula* in *Dysoxylum*.

Anthocarapa nitidula (Benth.) T.D. Penn. ex Mabb.

Anthocarapa nitidula (Benth.) T.D. Penn. ex Mabb., Blumea 31 (1985) 133; in Fl. Nouv.-Caléd. et Dép. 15 (1988) 71, t. 13. — *Amoora nitidula* Benth., Fl. Austral. 1 (1863) 383; C.DC. in DC., Monogr. Phan. 1 (1878) 590; F.M. Bailey, Queensl. Fl. 1 (1899) 233; Maiden, For. Fl. N.S.W. 3 (1907) 129, t. 105; F.M. Bailey, Compreh. Catal. Queensl. Pl. (1913) 88. — *Pseudocarapa nitidula* (Benth.) Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 315, incl. var. *latifolia* Merr. & L.M. Perry; Francis, Rain For. Trees Austral. (1951) 214.

Carapa moluccensis auct. non Lam.: Span., Linnaea 15 (1841) 183, quoad spec. p.p.

Amoora balansaeana C.DC. in DC., Monogr. Phan. 1 (1878) 590 ('*balanseana*'); Sarlin, Bois For. Nouv.-Caléd. (1954) 170, t. 73. — *Anthocarapa balansaeana* (C.DC.) Pierre, Fl. For. Cochinch. 5 (1897) sub t. 343; Guillaumin, Bull. Soc. Bot. Fr. 81 (1934) 246; T.D. Penn., Blumea 22 (1975) 501, t. 13b.

Amoora vieillardii C.DC. in DC., Monogr. Phan. 1 (1878) 591. — *Anthocarapa vieillardii* (C.DC.) Pierre, Fl. For. Cochinch. 5 (1897) sub t. 343; Guillaumin, Bull. Soc. Bot. Fr. 81 (1934) 246.

Dysoxylum oubatchense Harms, Bot. Jahrb. 39 (1906) 144.

Anthocarapa sp.: T.D. Penn., Blumea 22 (1975) 501, t. 13c.

Tree to 30 m; bole to 65 cm diam., often crooked; buttresses nil or small, to 1 m tall, steep, thin; crown dense with ascending branches. Bark grey-brown, smooth, lenticellate to shallowly vertically fissured; inner bark red but pinkish-brown within, *Toona*-scented or sometimes onion-scented (Maiden, l.c.); sapwood cream; heartwood pinkish. *Twigs* smooth, dark brown, streaked grey; leafy twigs 3–5 mm diam. Apical buds minute, densely adpressed sericeous. *Leaves* 15–37 cm, (1–)2–3(–5 on epicormics)-jugate, subglabrous, sometimes with onion-smell when fresh, coriaceous, subglabrous, drying yellowish; petiole 3.4–4.5 cm, swollen at base, ± flattened adaxially in sicco; rachis 5–10(–13) cm. *Leaflets* opposite, 7–20 by 3–8.5 cm, oblong-elliptic to obovate, base attenuate-cuneate, resembling a petiolule c. 1–1.5 cm long, swollen and blackish at base in sicco, apex obtuse to rounded, rarely subacute, costae c. 6–8 on each side, looped together up to one third from margin, they and the midrib ± prominent on both surfaces in sicco. *Thyrses* to 15 cm, axillary to supra-axillary, proximal branches longest to c. 6 cm with secondaries to c. 3 cm, bearing solitary flowers or cymules of up to c. 5 flowers; axes thinly adpressed sericeous; bracts and bracteoles c. 0.75 mm, narrowly triangular, adpressed sericeous. *Flowers* sweetly scented, pedicel c. 2 mm, articulated with pseudopedicel, 2–5 mm, ± pubescent. *Calyx* continuous with pseudopedicel, c. 3 mm diam. and salveriform or shortly cupular, rather irregularly 5-lobed, pubescent without, green. *Petals* 5, c. 2–3 mm long, oblong, acute, adpressed pubescent without, creamish-white. *Staminal tube* glabrous, fleshy, pale cream; anthers 10, elliptic. *Ovary* and style ± adpressed pubescent. *Fruits* solitary or paired, axes up to 8 cm long, pedicels 7 mm diam., pericarp c. 5 cm long and in diam., globose-pyriform, scaling, brown, somewhat woody, 1–3-seeded, distinctly asymmetric when 1-seeded. *Seeds* c. 3 cm

long, 1.5 cm diam., flattened adaxially, convex abaxially; sarcotesta scarlet; cotyledons green. — **Fig. 21.**

Distribution — Solomon Islands, Australia (Queensland, northern New South Wales), New Hebrides, New Caledonia; *Malesia:* (?) Philippines (see Note), Celebes (Djampea), Lesser Sunda Islands (Flores, Timor), New Guinea (Irian Jaya: Manokwari; Papua New Guinea: E Highl., Western and Central Provinces).

Habitat — Predominantly monsoon and hill forest, to 1400 m altitude.

Vernacular name — L. Bangko (Flores).

Uses — In Australia, the timber is used for flooring, cases, etc. (Francis, l.c.). Notes on the wood anatomy are provided by Sarlin (l.c.) and Pennington (l.c.), who also gives a detailed description of pollen features.

Note — The Philippine record is based on *Loher 255* (K, LE, M, P, US) from Luzon, Mt Arayat, a specimen previously referred to *Pseudocarapa* Hemsl.; its vegetative parts and overall floral morphology including pollen features fit *Anthocarapa*, though the (male) flowers are 4-petalled, and it may well represent a second species, resembling certain species of *Dysoxylum*.

CHISOCHETON

Chisocheton Blume, Bijdr. (1825) 168; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 301.
[*Schizochiton* Spreng., Syst. Veg. 4, 2 (1827) 251, nom. superfl.]
Dasycoleum Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 414.
Diplotaxis Wall. ex Kurz, Rep. Veg. Andam., ed. 2 (1870) 33, pro syn., sphalm. pro *Plagiotaxis*.
Megaphyllaea Hemsl. in Hook., Ic. Pl. 18 (1887) t. 1708.
Melioschinzia K. Schum. in K. Schum. & Hollr., Fl. Kaiser Wilh. Land (1889) 62.
Rhetinosperma Radlk. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, Nachtr. 3 (1908) 204.
Clemensia Merr., Philipp. J. Sc., Bot. 3 (1908) 143, non Schlecht. (1915), i.e. *Clemensiella* Schltr. (*Asclepiadaceae*).

Trees pachycaul to leptocaul, unbranched or, usually, with sympodial crown, sometimes laticiferous or myrmecophilous, very rarely foetid, dioecious or polygamous. *Indumentum* usually of simple, rarely of 4-stellate, hairs, sometimes irritant, with small glandular hairs. *Leaves* pinnate and pseudogemmulate or imparipinnate, very rarely paripinnate, to 2.4 m long; leaflets in 2–29 pairs. *Inflorescence* paniculate to thyrsoid or with long peduncle and congested racemose, axillary to supra-axillary, ramiflorous or rarely borne on congested cauliflorous branches, or epiphyllous (New Guinea). *Flowers* articulated with pedicel or inflorescence branches, sometimes with elongated receptacle (pseudopedicel). *Calyx* ± cupuliform, obscurely, rarely markedly, 3–6-lobed. *Petals* (3–)4–6(–14) in 1 (or 2) whorls, free, imbricate, quincuncial or alternative, often merely at apices, or valvate, rarely weakly united below or with base of staminal tube. *Staminal tube* cylindrical, sometimes weakly expanded or contracted at the mouth, margin entire, crenate or with 4–10(–30) emarginate, truncate or narrowly lanceolate 2- (or 3-)fid lobes; anthers (3–)4–10(–30), usually attached within the tube, alternating with lobes, usually locellate. *Disk* usually absent, less often stipitate, annular or patelliform, occasionally lobed. *Ovary* 2–8-locular, each locule with 1 or 2 collateral or superposed

orthotropus ovules; stylehead clavate or discoid. *Fruit* a 2–5(–8)-valved loculicidal capsule, the valves 1- (or 2-)seeded; pericarp usually leathery or almost completely lignified, sometimes laticiferous. *Seeds* obovoid-spheroid to scutelliform or orange-segment-shaped, variously arillate or sarcotestal, orthotropous; hilum often large and heavily vascularized, whitish; aril reddish orange with ± free flap over black testa; sarcotesta red, tough; cotyledons collateral, oblique or superposed. Germination semihypogeal. 2n = 46, 94.

Distribution — 50 species from Assam and tropical China throughout *Malesia* SE-wards to northern Queensland and the New Hebrides. Of the 46 in Malesia, all but 5 are endemic; three species are found only in continental Asia and one in the New Hebrides.

Habitat — Rain forest to 1500 m altitude, typically in the middlerange of tree-height, occasionally persisting in relict hedgerows, rarely colonists of clearings.

Uses — Locally, wood is used for construction but is not especially sought after.

Notes. 1. The pseudogemmulate leaves with their indeterminate growth have attracted considerable morphological attention (see Mabb., l.c., for a summary) as have the epiphyllous species [Dickinson, Bot. Rev. 44 (1978) 217; Fisher & Rutishauser, Can. J. Bot. 68 (1990) 2316]. Within the genus, there are species with imparipinnate leaves, paripinnate leaves (some forms of *C. patens*), but the majority have the leaf terminated by a pseudogemmula, which is a crozier-like bud of undeveloped leaflets, from which leaflets unfold at intervals. As in *Guarea* [Pennington, Fl. Neotropica 28 (1981) 6], the only other genus in which this occurs, some species are intermediate between the truly pseudogemmulate and the imparipinnate in that all the leaflets that will develop are produced in one flush, though the most apical may be tardy in expanding. Such is a common state of affairs in some species of *Dysoxylum* (q. v.). Inflorescences are borne in axillary, supra-axillary or ramiflorous positions. In each of these places and also on the bole, the inflorescences may be borne on dwarf shoots with reduced leaves. Such shoots are also known in *Melia* (q.v.), where they continue growth after fruit set. The epiphyllous inflorescences are borne on the adaxial surface of the leaf rachis, their vascular supplies being connected directly with that of the adjacent rachis, there being no adnation or other 'fusion'. In *C. tenuis*, there are also vegetative buds, their origin like that of the epiphyllous inflorescences in this species and *C. pohlianus* being considered heterotopic or, indeed, homoeotic.

2. From a consideration of the distributions and relationships of *Chisocheton* species occurring in southern Malaya, Corner [Gard. Bull. Sing., Suppl. 1 (1978) 198] considered the flora of the Sedili region to have been derived from the China Sea rivers of the glacial period. Whitmore [Wallace's Line (1981) 71–72], who illustrated the distribution of species according to Mabberley's monograph, considered the genus to be Sundaic in origin and to have spread to East Malesia. Mabberley [in Bramwell, Plants and Islands (1979) 270–272] showed how the most pachycaul species of particular alliances are very restricted in distribution compared with their leptocaul allies, a conclusion to be predicted from Corner's Durian Theory.

KEY TO THE SPECIES

(not including two insufficiently known species)

1a. Leaves paripinnate, without pseudogemmula or its scar ..... **28. C. patens**
b. Leaves imparipinnate or pseudogemmulate 2
2a. Inflorescences borne on leaves. — New Guinea 3
b. Inflorescences axillary, supra-axillary, ramiflorous or borne on bosses on bole . 4
3a. Leaves ± densely pubescent, petiolules 3–6 mm long ..... **14. C. pohlianus**
b. Leaves sparsely hairy to glabrous, petiolules (5–)10–23 mm long **10. C. tenuis**
4a. Inflorescences borne on long-lived bosses on bole. — Borneo 5
b. Inflorescences otherwise 6
5a. Leaflets strongly asymmetric, petals 5 or 6, red, anthers 8–10 (limestone) ..... **23. C. ruber**
b. Leaflets not so, petals (3) 4 (5), white, anthers 6–9 (mountains) ..... **27. C. cumingianus** (subsp. **kinabaluensis**)
6a. Pseudopedicel c. 10 mm long, calyx with conspicuous annular thickening, petals 6–10 in 2 whorls — Malay Peninsula ..... **31. C. perakensis**
b. Pseudopedicel, if present, much smaller 7
7a. Calyx (10–)13–20(–23) mm long. — Borneo, Philippines 8
b. Calyx smaller 9
8a. Leaflets ± densely fulvescent abaxially, inflorescence to 30 cm, petals 9–14, anthers 15–20, stylehead discoid, seeds sarcotestal ..... **2. C. medusae**
b. Leaflets not so, inflorescence to 220 cm, petals 6–10, anthers 16–30, stylehead capitate, seeds arillate ..... **1. C. macranthus**
9a. Leaves imparipinnate 10
b. Leaves pseudogemmulate 15
10a. Leaflets subglabrous abaxially — Sumatra, ?Java ..... **25. C. lasiogynus**
b. Leaflets golden- to brown-pubescent, pilose or strigose adaxially 11
11a. Anthers 3–5, corolla clavate in bud. — Malay Peninsula, Riau Arch. ..... **5. C. penduliflorus**
b. Anthers 6 or more 12
12a. Petals 16 mm long. — Borneo ..... **6. C. crustularii**
b. Petals 20 mm or longer 13
13a. Leaflets rugose, surface strongly reticulate-areolate abaxially, shiny and glabrous adaxially save brown-tomentose midrib; seed sarcotestal. — Malay Peninsula ... **3. C. tomentosus**
b. Leaflets smooth, abaxial surface not strongly reticulate-areolate; seeds arillate or unknown. — Borneo 14
14a. Leaves strigose with 'tinkling' hairs, petals glabrous ..... **7. C. setosus**
b. Leaves appressed hirsute abaxially, glabrous or sparsely pubescent on veins adaxially, petals densely pubescent without ..... **4. C. polyandrus**
15a. Petals 26–37 mm long, pachycaul treelets with irritant fruit hairs 16
b. Petals smaller, fruit unarmed 17

16a. Anther connective glabrous, seeds sarcotestal. — Malay Peninsula ..... **3. C. tomentosus**
b. Anther connective hairy, seeds arillate. — Borneo ..... **4. C. polyandrus**
17a. One or more petals narrower than and enclosed by the others 18
b. Petals ± the same width or, at least, none completely enclosed by the others .. 20
18a. Petals c. 8 mm long. — Sumatra ..... **34. C. diversifolius**
b. Petals 14 mm or longer 19
19a. Costae c. 5–8 on each side of midrib, leaves to 38 cm. — Malay Peninsula .... **33. C. pauciflorus**
b. Costae c. 15 on each side of midrib, leaves to 150 cm. — Borneo, Celebes .... **32. C. sarasinorum**
20a. Tube not conspicuously lobed or strongly crenulate (if unclear, follow the alternative) 21
b. Tube conspicuously lobed 35
21a. Calyx 5–6.5 mm. — Celebes, New Guinea 22
b. Calyx up to 4 mm tall 23
22a. Calyx 5–6.5 mm, shallowly cupulate. — Papua New Guinea **9. C. schoddei**
b. Calyx 5 mm, cylindrical-cupulate. — Celebes ..... **8. C. warburgii**
23a. Tube villous or sericeous without 24
b. Tube ± glabrous or at most sparsely hairy in middle or distal half without 29
24a. Anthers 8. — Philippines ..... **11. C. cauliflorus**
b. Anthers (3) 4–6 25
25a. Petals 5. — Sumatra ..... **18. C. aenigmaticus**
b. Petals (3) 4 26
26a. Petals glabrous, leaflets tomentose abaxially. — Celebes ... **19. C. celebicus**
b. Petals ± hirsute without 27
27a. Petals (3) 4, 7 mm long, ovary 4-locular. — New Guinea .. **13. C. montanus**
b. Petals 4, much longer 28
28a. Ovary bilocular, seeds 2, arillate ..... **24. C. sarawakanus**
b. Ovary 5-locular, seeds exarillate ..... **30. C. granatum**
29a. Inflorescence villous, to 80 cm, calyx 1.5–2 mm long, anthers 8 or 9, petiolules c. 12 mm. — New Britain ..... **12. C. novobritannicus**
b. Not this combination of characters 30
30a. Flowerbuds less than 1.5 mm diam. — New Guinea 31
b. Flowers larger 34
31a. Leaves with conspicuous venation on both sides (dry), coriaceous, glabrescent; petals c. 13.5 mm long, fruit rostrate ..... **21. C. sapindinus**
b. Leaves different, fruit not rostrate 32
32a. Petals c. 12 mm long, flowers crowded towards distal end of inflorescence, fruit spherical ..... **20. C. glirioides**
b. Petals up to 10 mm long, or, if slightly longer, then the tube villous within and the leaves pilose abaxially 33
33a. Flowerbuds 9–10 mm, anthers 4–6 (7), style to 0.15 mm ..... **17. C. sayeri**

b. Flowerbuds c. 11.5 mm, anthers 6–8, style 0.25 mm diam. . . **16. C. pilosus**
34a. Inflorescence borne on supra-axillary branch resembling supra-axillary inflorescence; petiolules fulvous tomentose, disk 1 mm ..... **22. C. laosensis**
b. Inflorescences different; disk absent ..... **15. C. lasiocarpus**
35a. Inflorescences borne on supra-axillary branch resembling supra-axillary inflorescence; petiolules fulvous tomentose ..... **22. C. laosensis**
b. Inflorescences different 36
36a. Hairs simple 37
b. Hairs stellate, disk present, seeds sarcotestal. — Borneo eastwards..... 50
37a. Corolla aestivation imbricate 38
b. Corolla aestivation valvate, seeds sarcotestal 46
38a. Costae 15–22 on each side of leaflet midrib, flowerbuds clavate, anthers 3–5, pachycaul treelet. — Malay Peninsula, Riau ..... **5. C. penduliflorus**
b. Not this combination of characters 39
39a. Ovary 4-locular, seeds (3) 4 40
b. Ovary 2-locular, seeds 2 42
40a. Disk obscure ..... **37. C. macrophyllus**
b. Disk prominent, subtubular to 1 mm 41
41a. Calyx 4–5-lobed, petals 5 or 6, anthers scarcely locellate ... **26. C. amabilis**
b. Calyx margin entire, petals (3) 4 (5), anthers locellate .. **27. C. cumingianus**
42a. Disk present 43
b. Disk absent 44
43a. Venation very prominent on both sides (dried), seeds 3 cm diam. — Borneo .... **29. C. lansiifolius**
b. Venation and seeds different ..... **28. C. patens**
44a. Petals 18 mm long. — Philippines ..... **35. C. mendozae**
b. Petals shorter 45
45a. Tube crenate, anthers hairy ..... **24. C. sarawakanus**
b. Tube lobes long-triangular, anthers glabrous ..... **28. C. patens**
46a. Disk present ..... **36. C. vindictae**
b. Disk absent 47
47a. Twigs subglabrous 48
b. Twigs fawn pubescent 49
48a. Petals 13–19 by 2 mm, tube lobes ± truncate, flowers in panicles, fruit 4.5 cm or more ..... **38. C. ceramicus**
b. Petals 8–12(–19) mm, tube lobes ± laciniate, flowers in panicles only if flowers small; fruit to 2.1 cm diam. ..... **40. C. pentandrus**
49a. Petals 16 mm long. — Philippines ..... **39. C. curranii**
b. Petals 9–13 mm long ..... **41. C. erythrocarpus**
50a. Flowers 11–12 mm long. — Borneo, Celebes ..... **42. C. koordersii**
b. Flowers less than 8 mm long..... 51
51a. Inflorescence velutinous, style glabrous. — New Guinea ... **43. C. stellatus**
b. Inflorescence subglabrous, style densely hairy ..... **44. C. longistipitatus**

Section Clemensia

Chisocheton sect. *Clemensia* (Merr.) Airy Shaw in Hook. Ic. Pl. 34 (1937) t. 3333; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 320. — *Clemensia* Merr. (genus), Philipp. J. Sc., Bot. 3 (1908) 143; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 155.

Chisocheton § *Graciles* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 295 (in sect. *Euchisocheton*); in ibid., ed. 2, 19b1 (1940) 153.

Pachycaul trees and treelets to 28 m tall, unbranched or sparsely branched. *Leaves* to 220 cm long, imparipinnate or pseudogemmulate. *Inflorescences* unbranched or sparsely branched, to 7 m long, ± flagelliform with arillate seeds, or shorter with sarcotestal seeds. *Calyx* ± pubescent, margin truncate or variously 3- or 4-lobed. *Petals* (4–)5–14, (16–)26–45 mm long, imbricate at apices. *Staminal tube* glabrous or sparsely pubescent without, with band of hairs below lobes and/or sparsely pubescent within up to apical quarter, margin entire to lobed; anthers 3–30, hairy or not, locellate or not. *Disk* flattened or annular, sometimes lobed. *Ovary* 4–6-locular; stylehead subdiscoid to capitate. *Capsule* to 13 cm diam., recurved, tomentose with stinging hairs. *Seeds* arillate or sarcotestal, never scutellar.

Distribution — Seven species restricted to western Malesia.

Note — The features which distinguish other sections intermingle here, so that sect. *Clemensia* may be considered a relict group from which the others have been derived. That is not to say, of course, that all features of this section are primitive.

1. **Chisocheton macranthus** (Merr.) Airy Shaw

Chisocheton macranthus (Merr.) Airy Shaw in Hook. Ic. Pl. 34 (1937) t. 3333; Jacobs, Reinwardtia 3 (1955) 266; Meijer, Bot. News Bull. Sabah 8 (1967); Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 320, t. 1. — *Clemensia macrantha* Merr., Philipp. J. Sc., Bot. 3 (1908) 144; J. Str. Br. Roy. As. Soc., spec. no. (1921) 321; Enum. Philipp. Flow. Pl. 2 (1923) 371; Univ. Calif. Publ. Bot. 15 (1929) 122; Elmer, Leafl. Philipp. Bot. 9 (1937) 3349; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 155, t. 34; Heine, Feddes Rep. 54 (1951) 230.

[*Dysoxylum dehiscens* Elmer, Leafl. Philipp. Bot. (1937) 3349, nom. in syn.]

Chisocheton medusae auct. non Airy Shaw: Heine, Mitt. Bot. Staatssamml. München 6 (1953) 233.

Pachycaul tree to 13 m; bole to 22 cm diam., buttressed. Branching fastigiate, often with several limbs from near base. Bark smooth. Leafy *twigs* to 5 cm diam., blackish, with large scutellar cicatrices. *Leaves* to 220 cm long, pseudogemmulate, crowded in dense terminal spirals; petiole 5–20 cm, woody, dark-coloured, glabrescent to sparsely hairy. *Leaflets* in up to 16 pairs, sometimes ± alternate at base or rachis, 20–45(–55) by (5–)8–12(–15) cm, oblong lanceolate or ovate when smaller, weakly bullate, glabrous adaxially, ± puberulous abaxially, base obtuse to subacute, apex acute to acuminate, costae c. 15–24 on each side, tertiary venation scalariform; petiolules to 8 mm. *Inflorescence* to 220 cm long, pendent; axis terete to weakly angled, weakly branched; branches crowded towards apex, pilose, with up to 12 flowers each; bracts c. 6 mm long, pubescent, caducous; pedicels c. 10 mm long, articulated with pseudopedicel. *Calyx* 14–20 mm long and across, cupular to cylindrical, pubescent, red-brown, margin truncate to irregularly 3- or 4-lobed. *Petals* 6–10, 30–45 by 4–7(–12) mm, creamy

pink. *Staminal tube* 25–40 by 6–7 mm, creamy white, glabrous without except on the lobes, pilose within at base, margin entire or with lobes 4–6 mm long; anthers 16–30, c. 5 mm long, rather recurved, connective somewhat pubescent. *Disk* flattened to weakly annular, glabrous. *Ovary* c. 5 mm diam., 5- or 6-locular, pilose; style pilose in proximal half or glabrous; stylehead c. 2 mm diam., capitate. *Infructescence* borne in axils of last flush of leaves; axis to 3 m with terminal bunches of up to 60 fruits. *Capsule* to 12 cm diam., recurved, rostrate when immature, bright vermilion tomentose with irritant deciduous hairs. *Seeds* 2.5–3.3 cm long, triangular in cross section; aril reddish, covering inner edges of black testa.

Distribution — *Malesia:* northern Borneo (Sarawak, Sabah, E Kalimantan) and southern Philippines (Surigao, Mindanao).

Habitat — Lowland rain forest including that on limestone, to 400 m altitude.

Note — The stinging hairs and pachycaul habit are found in a number of *Dysoxylum* species, e.g. *D. sessile* (q.v.).

2. **Chisocheton medusae** Airy Shaw

Chisocheton medusae Airy Shaw in Hook. Ic. Pl. 34 (1937) t. 3333; Jacobs, Reinwardtia 3 (1955) 264, incl. f. *hiascens* Jacobs; Meijer, Bot. News Bull. Sabah 8 (1967) 78; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 322.

Megaphyllaea sp.: Merr., Univ. Calif. Publ. Bot. 15 (1929) 123.

Pachycaul tree to 28 m; bole to 30 cm diam., sparsely branched, buttressed. Bark black with fine striations; inner bark dark brown; heartwood yellowish. Leafy *twigs* to 2.5 cm diam., fulvous tomentose. *Leaves* to 2 m long, pseudogemmulate (imparipinnate and up to 4-jugate when young), bunched in terminal spirals; petiole 10–20 cm, terete or flattened adaxially, decurrent with twig and forming axillary cavity with it, ± fulvous tomentose; rachis somewhat angular, glabrescent to fulvous tomentose. *Leaflets* in up to 14 pairs, opposite except for those near base of rachis, to 40 by 11 cm, lanceolate to elliptic-lanceolate, glabrous adaxially when mature, ± densely fulvous pubescent abaxially, green when young, base narrowed into petiole, apex acute to acuminate when tip to 2 cm long, midrib stout, densely fulvous tomentose abaxially, costae 20–24 on each side, weakly arcuate near margin, subpubescent adaxially, prominent and pubescent abaxially. *Inflorescences* to 30 cm long, borne in axils of upper or undeveloped leaves, weakly branched to narrowly paniculiform at base; axis flattened to angular, shortly fulvous tomentose when young, glabrescent later; branches rather more densely pubescent, few-flowered with caducous bracts; pedicels 3–20 mm, somewhat angular, light-brown hirtellous, articulated with pseudopedicel, swollen at articulation. *Calyx* (10–)13–20(–23) mm long, 15–20 mm diam., cupular to subcylindrical, ± densely ferrugineous-velutinous, margin truncate or irregularly split to halfway into 2 or 3 ± triangular lobes. *Petals* 9–14, 35–40 by 2–6 mm, white. *Staminal tube* 27–32 mm, glabrous, thin proximally, margin truncate; anthers 15–20, slightly exserted or included, 3–4 mm long, glabrous. *Disk* glabrous. *Ovary* in female flowers 3–5 mm diam., 7- or 8-locular, glabrous to densely yellow hairy; the style ± pubescent, especi-

ally below the stylehead 2 mm diam., discoid to shallowly cylindrical, glabrous. *Infructescence* to 30 cm. *Capsule* to 13 cm long, 10 cm diam., golden brown, densely hispid. *Seeds* to 5 cm long and orange-segment-shaped; the sarcotesta densely vascularized. — **Fig. 22.**

Distribution — *Malesia:* in northern Borneo (Sarawak, Sabah, E Kalimantan).

Habitat — Lowland rain forest to 300 m altitude, sometimes on limestone.

Note — This species has a short infructescence with sarcotestal seeds whereas its apparently closest ally *Chisocheton macranthus* has a flagelliform infructescence and arillate seeds. *Chisocheton tomentosus* (sarcotesta) and *C. polyandrus* (aril) are a similar pair but geographically vicarious.

Fig. 22. *Chisocheton medusae* Airy Shaw. Shoot tip with young leaves. Sabah, Sepilok Forest Reserve (*Mabberley 1680*). Photograph D. J. Mabberley, May 1974.

3. **Chisocheton tomentosus** (Roxb.) Mabb.

Chisocheton tomentosus (Roxb.) Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 323, f. 1 (2); in Tree Fl. Malaya 4 (1989) 238. — *Melia tomentosa* Roxb., Hort. Beng. (1814) 90, nom. nud.; G. Don, Gen. Syst. 1 (1831) 681, nom. nud.; Roxb., Fl. Ind., ed. Carey, 1 (1832) 394; Walp., Rep. 1 (1842) 427; M. Roem., Synops. Monogr. 1 (1846) 96; Hiern in Hook. f., Fl. Brit. India 1 (1875) 543; C. DC. in DC., Monogr. Phan. 1 (1878) 458; Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 21. — *Azedarach tomentosa* (Roxb.) Kuntze, Rev. Gen. Pl. 1 (1891) 110.

[*Meliacea rugosa* Wall., Cat. (1831/2) n. 4891, nom. nud.]

Chisocheton princeps Hemsl. in Hook. Ic. Pl. 19 (1889) t. 1884; Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 22; King, J. As. Soc. Beng. 64, ii (1895) 29; Ridley, Fl. Malay Penins. 1 (1922) 388; Whitmore, Trop. Rain For. Far East (1975) t. 2.7.

Chisocheton rubiginosus King, J. As. Soc. Beng. 64, ii (1895) 29; Ridley, Fl. Malay Penins. 1 (1922) 389; Burkill & Hend., Gard. Bull. Str. Settl. 3 (1925) 357.

Chisocheton rugosus Pierre, Fl. For. Cochinch. 5 (1897) sub t. 347.

Pachycaul tree to 21 m; bole to 20 cm diam., unbranched or sparsely and fastigiately branched, often from near base, sometimes slightly fluted below, knobbled or with small stiltroots, taprooted at least when young. Bark blackish brown, smooth to weakly fissured, with conspicuous scutellar cicatrices to 5 cm wide and long above; inner bark deep orange-yellow to brownish; sapwood ivory to fawn; pith wide, soft, white. Leafy *twigs* to 2 cm diam., all young parts brown-tomentose with irritant hairs, sometimes inhabited by ants [Pannell, Kew Bull., Add. Ser. 16 (1992) 16]. *Leaves* to 2 m long, in terminal rosettes, maturing in flushes, pinkish red when young, imparipinnate, especially on saplings, or pseudogemmulate, pseudogemmula sometimes falling without further development, petiole 10–20 cm, terete, base swollen, massive, woody; rachis often angled, brown-tomentose. *Leaflets* 3–37 by 2–10 cm, the most proximal smallest, narrowly elliptic to oblong, sessile to subsessile, patent, rugose, shiny and glabrous adaxially except for brown-tomentose midrib, tomentose or tawny pubescent abaxially, surface strongly reticulate-areolate, costae 12–30 on each side, arcuate. *Inflorescences* borne in upper axils, appearing when fruit on old infructescences maturing (female trees), to 90 cm; axis massive, tough with flowers forming a terminal head to 45 by 10 cm, sometimes with short branches to 7 cm, composed of fascicles of sweetly scented pedicellate flowers, brownish pink in bud. *Calyx* (3–)4–8 mm tall and in diam., cupular, reddish brown, minutely puberulous, often warty, margin entire or obscurely 3- or 4-lobed, ± setose. *Petals* 5 or 6(–10), 26–37 mm long, linear-spathulate, creamy red-striped without, white flushed pink within, waxy, concave distally, densely pilose without. *Staminal tube* cylindrical, slightly widened at mouth, villous with downward-pointing hairs within lower 3/4, sometimes sparsely hairy without especially just below lobes, lobes c. 10–15, often irregularly bifid, shorter than anthers; anthers 7–13(–15), 4.5–5 mm long, boat-shaped, locellate, glabrous, basifixed. *Disk* to 1 mm tall, annular, apically pilose. *Ovary* (4-) 5- (6-)locular; style cylindrical, sparsely pubescent; stylehead spherical. *Capsule* to 7 cm diam., subglobular, (4-) 5- (6-)locular, golden brown velvety with deciduous irritant hairs. *Seeds* 3–5, to 4 cm long; sarcotesta white.

Distribution — *Malesia:* Sumatra (Barisan Range, *De Vogel 2750*, L), Malay Peninsula.

Habitat — Lowland and hill dipterocarp forest to 400 m altitude.

Note — The type is a drawing prepared for Roxburgh when the tree was at Calcutta Botanic Garden and is reproduced in Ic. Roxb. Drawings Ind. Pl. 3 (1969) 16.

4. **Chisocheton polyandrus** Merr.

Chisocheton polyandrus Merr., Philipp. J. Sc. 21 (1922) 520; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 324, t. 2 & f. 1 (1).

Pachycaul tree to 15 m, unbranched or very sparsely branched, occasionally with stiltroots or small buttresses; inner bark pinkish; wood fawn. *Leaves* to 150 cm long, imparipinnate to 14-jugate or pseudogemmulate, when pseudogemmula densely long pubescent; petiole 1–5 cm, terete, woody; rachis terete. *Leaflets* 11–43 by 5–13 cm, oblong-lanceolate, opposite or subalternate at base of rachis, where they are often very

small and even irregularly lobed, shiny, bullate at altitude, glabrous or veins ± pubescent adaxially, appressed hirsute, particularly at altitude abaxially, base asymmetrical, cuneate to subcordate, apex somewhat acuminate, costae c. 15 on each side, often sunken adaxially; petiolules to 2 mm. *Inflorescences* borne in upper axils, up to 4 at a time, to 2 m long, unbranched or with a few squarrose branches to 13 cm long near tip, where flowers are condensed; axes ferruginous-pubescent when young. *Calyx* 5–8 mm long, 5–6 mm in diam., cupular to subcylindrical, densely ferruginous pubescent, green to deep red, margin truncate. *Petals* 5 or 6, 28–32 mm long, subspathulate, fleshy, creamy white with conspicuous pink or red tinge, densely pubescent without. *Staminal tube* cylindrical, white, subglabrous save conspicuous bands of hairs apically and basally within, margin with c. 12–14 linear lobes, c. 3 mm long; anthers 12–14, c. 4 mm long, locellate, connective scattered ferruginous-pubescent. *Disk* c. 1 mm tall, thick, glabrous, margin truncate. *Ovary* ?3–5-celled; style cylindrical glabrous; stylehead subcapitate, c. 1 mm diam. *Infructescence* to 2 m long, pendent, with fruit aggregated at tip. *Fruit* spherical, covered with reddish irritant hairs, splitting into 3 or 4 valves. *Seeds* 3; testa black, covered on inner surface by orange-red aril.

Distribution — *Malesia:* Borneo (northern Sarawak, Brunei, Sabah, S Kalimantan).

Habitat & Ecology — Lowland and hill dipterocarp forest, 150–300 m altitude. Flowers are visited by spiderhunters.

5. Chisocheton penduliflorus Planch. ex Hiern

Chisocheton penduliflorus Planch. ex Hiern in Hook. f., Fl. Brit. India 1 (1875) 550; C.DC. in DC., Monogr. Phan. 1 (1878) 536, t. 7 f. 4; Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 22; King, J. As. Soc. Beng. 64, ii (1895) 38; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 292, t. 162 f. E–G; ed. 2, 19b1 (1940) 139, t. 30 f. E–G; Ridley, Fl. Malay Penins. 1 (1922) 388, incl. var. *kunstleri* (King) Ridley; Burkill & Hend., Gard. Bull. Str. Settl. 3 (1925) 356; Briq., Mém. Inst. Nat. Genev. 24 (1935) 66; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 326; Mal. For. 45 (1982) 451; in Tree Fl. Malaya 4 (1989) 237. — [*Melia penduliflora* Wall., Cat. (1828) n. 1255, nom. nud.; M. Roem., Synops. Monogr. 1 (1846) 96, nom. nud.]

Chisocheton kunstleri King, J. As. Soc. Beng. 64, ii (1895) 27.

Pachycaul treelet or tree to 10 m; bole to 10 cm diam. Bark blackish; inner bark pale fawn. Leafy *twigs* 6–7 mm diam. (–15 mm in fruit), ± densely to rusty tomentose. *Leaves* imparipinnate or pseudogemmulate, to 8-jugate; petiole to 22 cm, ± channelled adaxially. *Leaflets* (8–)17–27.5 by (3–)8–11.5 cm, elliptic-ovate to elliptic-oblong, subcoriaceous, subglabrous except for ± fulvescent-tomentose on veins adaxially, ± pubescent particularly on veins abaxially, base rounded to subcordate, sometimes asymmetrical, apex ± gradually long-acuminate, costae c. 15–22 on each side with conspicuous secondaries, prominent abaxially; petiolules to 1 mm. *Inflorescence* to 7 m, supra-axillary, pendent, unbranched or with distal branches to 7 cm long, usually with flowers congested in subsessile cymes at distal end, like a bellrope; axis 3–5 mm diam., densely rusty tomentose; bracts and bracteoles linear, hirsute. *Calyx* 3–4 mm tall, cupular to shortly cylindrical, pubescent, margin truncate to obscurely lobed. *Corolla* clavate in bud. Petals 4 or 5, 18–22 mm long, linear-spathulate, concave, thick, dull red, pubescent without, adnate to staminal tube below. *Staminal tube* pilose without below lobes,

long-pilose with downward directed hairs in lower half within, margin with 3–5 irregularly bifid lobes; anthers 3–5, c. 3 mm long, locellate, glabrous, included or slightly exserted. *Disk* obscure to shallowly cupular, fleshy, glabrous. *Ovary* 3(?–5)-locular, densely long-pilose; style densely long-pilose in proximal 3/4; stylehead subdiscoid to capitate with ± pubescent annulus. *Capsules* in infructescences of c. 10–15, to 5 cm long, recurved, rostrate when young, silky pubescent with (?)irritant hairs, splitting into 3 valves. *Seeds* 3; testa black, covered on inner surface by red-orange aril.

Distribution — Lower Thailand and *Malesia:* Malay Peninsula, Riau/Lingga Archipelago.

Habitat — Lowland rain forest to 900 m altitude.

6. **Chisocheton crustularii** Mabb.

Chisocheton crustularii Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 327, f. 3.

Pachycaul tree to 8 m; bole to 8 cm diam., sometimes with small rounded buttresses. Bark greyish, narrowly fissured. Leafy *twigs* c. 1.5 cm diam. *Leaves* to 135 cm long, imparipinnate, to 10-jugate; rachis terete, subglabrous, lateral leaflets opposite to 38 by 10 cm distally, 1.8 by 1 cm and pseudostipulate proximally, the terminal c. 45 by 13.5 cm, narrowly elliptic or oblong, glabrous adaxially, sparsely strigose, especially on venation abaxially, base shortly attenuate to subtruncate, apex acuminate, costae c. 24 on each side, prominent abaxially, tertiary venation conspicuous, somewhat scalariform; petiolules 0–16 mm, swollen. *Inflorescence* (male only known) 38(–150) cm long, pendent, slender; axis 2–3 mm diam., sericeous, the flowers in fascicles in the distal half; pedicels 2–4.5 mm, recurved, hispid. *Calyx* 3 mm long, c. 5.5 mm diam., cupular, pubescent without, margin entire to weakly crenate. *Petals* 5, 16 by 4.5 mm, narrowly oblong, white, appressed pilose without, glabrous within. *Staminal tube* 14.5 mm long, subglabrous save broad band of adpressed hairs apically without, margin with 11 irregularly bifid lobes c. 3.5 mm long; anthers 11, c. 2 mm long, included, hardly locellate. *Disk* c. 0.5 mm tall, margin with recurved lobes. *Style* filiform with a tuft of long hairs at its base; stylehead c. 1 mm diam., spherical. *Fruit* unknown.

Distribution — *Malesia:* Borneo, known from only two collections from Tinjar, N Sarawak.

Habitat — Presumably rain forest.

7. **Chisocheton setosus** Ridley

Chisocheton setosus Ridley, Bull. Misc. Info. Kew (1930) 366; Airy Shaw in Hook. Ic. Pl. 34 (1937) t. 3334; Meijer, Bot. News Bull. Sabah 8 (1967) 78; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 327.

Pachycaul treelet to 5 m, ?unbranched; bole c. 8 cm diam. Bark smooth; inner bark pale yellow. Leafy *twigs* c. 1 cm diam., densely ferruginous-setose. *Leaves* to 1 m long, imparipinnate, at least 6-jugate; petiole to 35 cm long, subterete, sometimes

grooved adaxially, to 6 mm diam., ferruginous-setose with hairs 2–3 mm long, base swollen with conspicuous hollow at junction with shoot; rachis 1- or 2-sulcate, setose as petiole. *Leaflets* ± densely ferruginous setose on both sides, setae tinkling when stroked (in sicco), pale when dry, proximal leaflets to 20 by 8.5 cm, elliptic oblong, distal to 36 by 10 cm, oblanceolate to oblong, base rounded to attenuate, apex acuminate, acumen 10–20 mm, costae 17–20 on each side, prominent abaxially, tertiary venation ± prominently scalariform; petiolules 5–6 mm long, densely tomentose, that of terminal leaflet to 10 mm. *Inflorescence* to 2 m, pendulous, ± densely setose, drying irregularly angled with flowers crowded in condensed cymes at distal end like a bell-rope; bracts c. 7 mm long, setose. *Flowers* recurved, shortly pedicellate. *Calyx* c. 3 mm long and 4 mm diam., cupular, somewhat elongated into a pseudopedicel, reddish, setose to pubescent, margin truncate to obscurely 3- or 4-lobed. *Corolla* 3–3.5 cm long, c. 3 mm diam., weakly clavate, glabrous, white or greenish; petals 4–6, to 4 mm wide, subspathulate, imbricate at spices. *Staminal tube* to 3.2 cm long, glabrous except for a band of hairs below lobes without, white, margin with 6–8 truncate or irregularly lobed lobes; anthers 6–8, c. 2 mm long, glabrous, scarcely locellate. *Disk* c. 1 mm tall, cupular, glabrous, margin truncate to obscurely lobed. *Ovary* in female flowers unknown; style sparsely pilose proximally, glabrous distally; stylehead capitate, distinctly narrow-annular apically. *Fruit* (unripe) pale yellow, densely setose.

Distribution — *Malesia:* Borneo (Sarawak, Brunei, Sabah, C Kalimantan). Collected only five times.

Habitat — Presumably rain forest.

Section Chisocheton

Chisocheton sect. *Chisocheton*: Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 329. — *Chisocheton* sect. *Euchisocheton* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 295, p.p. — *Schizochiton* Spreng. sect. *Euschizochiton* Kuntze in T. Post & Kuntze, Lex. Gen. Phan. (1903) 505, nom. superfl.

Chisocheton sect. *Tetrapetalum* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 26. — *Chisocheton* § *Tetrapetali*: (Miq.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 151.

Chisocheton sect. *Hexapetalum* Miq., l.c.

Trees or undergrowth treelets. *Indumentum* of simple hairs. *Leaves* pseudogemmulate, rarely imparipinnate (*C. lasiogynus*) or paripinnate (*C. patens*, p.p.). *Inflorescences* axillary, ramiflorous, cauliflorous or epiphyllous, or borne on supra-axillary branches. *Corolla* aestivation alternative, quincuncial or imbricate, white or cream to pink or red; petals 4–6. *Staminal tube* lobed or not; anthers (3–)5–10(–18), locellate. *Disk* sometimes present. *Ovary* 2–8-merous; stylehead capitate. *Fruit* unarmed. *Seeds* 3–6, arillate.

Distribution — 23 species throughout the range of the genus except Australia and New Hebrides.

Notes — 1. The species are arranged in two series though these are linked by a small number of species which could be placed in either.

2. Allied to sect. *Clemensia* through arillate species of the latter.

Series Schumanniani

Chisocheton sect. *Chisocheton* series *Schumanniani* Harms ex Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 329. — *Chisocheton* § *Schumanniani* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 153, nom. non rite publ.

Leaves pseudogemmulate. Inflorescences (supra-)axillary or epiphyllous. Ovary 3–8-locular. Aril covering only half of testa.

Distribution — 14 species from Celebes to the Solomon Islands, with 1 in Sumatra.

8. **Chisocheton warburgii** Harms

Chisocheton warburgii Harms in Fedde, Rep. 42 (1937) 9; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 372; Mal. For. 45 (1982) 451.

Tree to 7 m. *Branchlets* ± densely hirsute-villous, leafy ones c. 1 cm diam. *Leaves* c. 1 m long, at least 15-jugate; petiole 7–15 cm, ± villous. *Leaflets* 9–18 by 4–6 cm, oblong to oblanceolate or oblong-ovate, ± pilose abaxially and sometimes on veins adaxially, bases acute to obtuse, ± asymmetric, apices narrowly acute, costae c. 10–16 on each side, arcuate, prominent abaxially in sicco; petiolules 5–10 mm, ± pilose. *Thyrse* spiciform, to 1 m or more long, (to 280 cm in fruit) supra-axillary, the flowers on short branches or in fascicles forming a head in distal 40 cm; axis c. 5 mm diam., ± pilose. *Flowers* subsessile. *Calyx* c. 5 mm long, 4 mm diam., cylindrical cupulate, densely villous without, margin truncate. *Petals* 4 or 5, 10–15 by 2–3 mm, the innermost narrowest, ligulate, narrowly imbricate, adpressed pubescent without. *Staminal tube* subcoriaceous, ± with a sparse region of hairs outside near apex, glabrous within, margin truncate; anthers 8 or 9 (10), linear inserted c. 2 mm within throat, included, basifixed. *Ovary* densely villous; style glabrous apically; stylehead clavate-capitate. *Capsule* c. 5 cm diam., warty, ± pubescent, recurved 4-valved, the valves woody, recurved, shortly and abruptly stipitate, apex weakly beaked. *Seeds* 4, c. 2.5 cm long, orange-segment-shaped.

Distribution — *Malesia:* C and N Celebes.

Habitat — Rain forest, 400–500 m altitude.

Note — Flowering material was recollected by Kjellberg in Central Celebes in 1929, but the plant is known from only four surviving collections.

9. **Chisocheton schoddei** P.F. Stevens

Chisocheton schoddei P.F. Stevens, Contr. Herb. Austral. 11 (1975) 38, t. 5; in Handb. Fl. Papua New Guinea 1 (1978) 161, t. 78; Mabb., Bull. Brit. Mus. Nat. Hist. 6 (1979) 329.

Pachycaul tree to 12 m; bole to 15 cm diam. Bark brown to greenish grey, rather smooth; inner bark creamy white to fawn. Leafy *twigs* c. 7–8 mm diam., ± terete, pubescent when young. *Leaves* to 1.3 m, bunched in terminal spirals; petiole 10–15 cm; axis c. 3.5 mm diam., ± terete. *Leaflets* in up to 10 pairs, 12–38(–50) by 6.5–14.5 (–20) cm, though most proximal much smaller, about 10 cm apart, ovate to oblong,

sparsely pubescent adaxially, slightly more so abaxially, base ± subcordate, apex acuminate, costae 8–14 on each side, venation prominent abaxially. *Thyrse* to 1.2 m long, narrowly paniculate, borne in foliate axils; axis ± pubescent, unbranched or with distal branches to 5 cm long; bracts c. 2 mm long, broadly ovate. *Calyx* 5–6.5 mm long, shallowly cupulate, pubescent without, margin truncate. *Petals* (4) 5 or 6, to 17 by 7 mm, ligulate, elliptic, red without, white to greenish within, ± pubescent without. *Staminal tube* densely hairy within, less so without; margin truncate to crenulate; the anthers 10–12, c. 3 mm long, locellate, connective ± pubescent. *Ovary* c. 4 mm in diam., (4-) 5–8-locular, densely pubescent; the style pubescent for most of its length, occasionally glabrous near apex; stylehead c. 1.5 mm diam., capitate. *Infructescence* to 65 cm; rachis c. 4 mm diam. *Fruits* crowded at apex, 6 cm in diam., flattened globose, (4–)6(–8)-merous, densely tomentose, pericarp thick, creamy. *Seeds* up to 6, c. 18 mm long; testa black; aril orange-red covering adaxial half. — **Fig. 23.**

Distribution — *Malesia:* southern Papua New Guinea.

Habitat — Rain forests to 180 m altitude.

Fig. 23. *Chisocheton schoddei* P.F. Stevens. P. Katik holding a fruiting twig. Papua New Guinea, Brown River (*Mabberley 1773*). Photograph D. J. Mabberley, July 1974.

10. **Chisocheton tenuis** P.F. Stevens

Chisocheton tenuis P.F. Stevens, Contr. Herb. Austral. 11 (1975) 46, t. 7; P.F. Stevens in Handb. Fl. Papua New Guinea 1 (1978) 168, t. 81; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 330; Fisher & Rutishauser, Can. J. Bot. 68 (1990) 2317.

Chisocheton pohlianus auct. non Harms (1917): Harms, Bot. Jahrb. 72 (1942) 187, quoad spec. cit.

Tree to 8 m; bole to 7.5 cm diam. with ascending branches. Bark pale fawn; inner bark straw. Leafy *twigs* c. 4 mm diam. *Leaves* to 70 cm long, up to 7-jugate; petiole 5–10 cm; rachis 2–3 mm diam., terete with minute pseudogemmula and inflorescence scars and minute vegetative (Fisher & Rutishauser, l.c.) and inflorescence buds. *Leaflets* 7.5–25 by 3.3–9.5 cm, obovate to elliptic, ± glabrescent except for hairier midrib, apex weakly acuminate, costae 6–12 on each side; petiolules (5–)10–23 mm long. *Inflorescence* to 9 cm long, not or sparsely branched, epiphyllous and usually arising near petiolules; bracteoles to 1.5 mm long; pedicels 2–12 mm. *Calyx* 3–4 mm long, cupulate to cylindrical with pseudopedicel c. 1 mm long, pubescent, margin truncate, sometimes ± split at one point. *Petals* 4, 7.5 mm long, ± densely adpressed pubescent without, pinkish, alternative. *Staminal tube* c. 6.5 mm long, pubescent within and, except at top and bottom, without, margin ± truncate; anthers 7 or 8, c. 2 mm long, locellate, inserted c. 3 mm within tube, connective pubescent. *Disk* small. *Ovary* pubescent (female flowers unknown); style with long ascending hairs except near apex; stylehead c. 0.5 mm diam. *Fruits* to 6 cm long, 2.3 cm diam., fusiform, 3- or 4-locular, ± pubescent. *Seeds* 3 or 4, c. 18 mm long, ± ellipsoid; testa black; aril orange-red, covering adaxial surface.

Distribution — *Malesia:* New Guinea (W Sepik Province and highlands of Papua New Guinea).

Habitat — Lowland and lower montane rane forest, to 1700 m altitude.

11. **Chisocheton cauliflorus** Merr.

Chisocheton cauliflorus Merr., Philipp. J. Sc., Bot. 11 (1916) 188 ('*Chisochiton*'); Enum. Philipp. Flow. Pl. 2 (1923) 366; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 330.

Treelet to 3 m; bole to 4 cm diam.; young parts ± fulvous villous or hirsute. Leafy *twigs* c. 5 mm diam., glabrous. *Leaves* to 50 cm long, to 6-jugate; petiole c. 10 cm, ± conspicuously fulvescent like rachis. *Leaflets* 10–22 by 4–7 cm, oblong or (proximal ones) elliptic and weakly lobed, bases ± rounded, apices acuminate, costae 8–15 on each side, venation ± conspicuously fulvescent abaxially, prominent; petiolules 5–10 mm long. *Inflorescences* to 50 cm, narrowly paniculiform, borne on tubercles on trunk, branches, or axillary; axis 1.5 mm diam., ± prominently fulvous villous, with few, few-flowered branches to 4 cm. *Calyx* 4–5 mm long, cupular to cylindrical, ± densely adpressed fulvescent, margin truncate. *Petals* 4, to 18 mm long, spathulate, pinkish red, ± subvillous without, alternative. *Staminal tube* c. 16 mm long, cylindrical, villous without, glabrous within, margin truncate; anthers 8, c. 2 mm long, locellate, glabrous, inserted c. 1.5 mm within tube. *Ovary* densely villous; style adpressed pubescent except in distal third; stylehead subcapitate. *Female flowers* and *fruits* unknown.

Distribution — *Malesia:* Philippines (Samar, Mindanao).

Habitat — Lowland rain forest, to 470 m altitude.

Note — The Mindanao material is somewhat less pubescent than the material from Samar.

12. **Chisocheton novobritannicus** P.F. Stevens

Chisocheton novobrittannicus P.F. Stevens, Contr. Herb. Austral. 11 (1975) 22, t. 3; in Handb. Fl. Papua New Guinea 1 (1978) 151, t. 73; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 331.

Tree to 13 m; bole to 20 cm diam. Leafy *twigs* c. 6 mm diam., terete, long villous when young. *Leaves* to 125 cm long, to 11-jugate; petiole 5–15 cm, rachis 5 mm diam. *Leaflets* 13–37 by 6.5–15 cm, ovate to oblong, subglabrous adaxially or venation ± pubescent, abaxially glabrous save fine venation, bases rounded, sometimes asymmetric, apices acute to acuminate; costae 10–17 on each side; petiolules to 12 mm. *Inflorescences* to 80 cm long, axillary, narrowly paniculiform, 2-branched with branches to 2 cm, patent or reflexed, the flowers ± sessile. *Calyx* 1.5–2 mm deep, shallowly cupular, with pseudopedicel c. 1 mm long, pubescent without, margin truncate. *Petals* 4, c. 16 mm long, alternative, white, glabrous without except sometimes pubescent near apex. *Staminal tube* c. 14 mm long, glabrous or with spreading hairs near base within, margin truncate to very shallowly lobed; anthers 8 or 9, 1.5–2.5 mm long, locellate, glabrous. *Disk* c. 0.5 mm tall, glabrous. *Ovary* small (female flowers unknown); style densely pubescent in proximal half; stylehead c. 1 mm diam. *Capsule* c. 3.2 cm diam., 4-locular, sparsely pubescent. *Seeds* c. 2 cm long, ellipsoid; aril on adaxial surface.

Distribution — Bismarck Archipelago (New Britain).

Habitat — Lowland rain forest, to 150 m altitude.

13. **Chisocheton montanus** P.F. Stevens

Chisocheton montanus P.F. Stevens, Contr. Herb. Austral. 11 (1975) 18, t. 2; in Handb. Fl. Papua New Guinea 1 (1978) 147, t. 71; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 331; Fisher & Rutishauser, Can. J. Bot. 68 (1990) 2320.

Tree to 8 m; bole to 24 cm diam. Bark dark brown, darker within; inner bark reddish. Leafy *twigs* to 3 mm diam. *Leaves* to 75 cm long; petiole 5–15 cm long, 2.5 mm diam., terete. *Leaflets* in up to 13 pairs, 4.5–30 by 2.7–9 cm, obovate or elliptic to oblong, the proximal often conspicuously smaller than the distal, fulvous pubescent abaxially and on major venation adaxially, bases acute to cuneate; apices ± acuminate, costae c. 7–15 on each side, venation weakly prominent abaxially; petiolules to 6.5 mm, pubescent. *Inflorescence* to 18 cm, weakly scented, paniculiform, borne in leafy axils, though subtending leaf sometimes unexpanded, velutinous; axis unbranched (? female) or with branches to 2.5 cm (male); bracts to 3 mm long, subulate. *Calyx* 3–4 mm long, cupulate, pubescent without, margin truncate. *Petals* (3 or) 4, c. 7 by 2 mm, creamy white, pubescent without. *Staminal tube* weakly adnate to corolla, c. 6 mm long, sericeous without though sometimes glabrous at base, glabrous within though sometimes with a few hairs at base, margin ± entire; anthers (5) 6, c. 1.5 mm long, locellate, inserted c. 3 mm within tube, connective glabrous to sparsely hairy. *Ovary* 4-locular; style to 6 mm long, glabrous or with hairs in proximal half. Mature *female flowers*, *fruits* and *seeds* unknown.

Distribution — *Malesia:* Papua New Guinea.

Habitat — Lower montane forest (disturbed), 1450–1850 m altitude.

14. Chisocheton pohlianus Harms

Chisocheton pohlianus Harms, Ber. Deutsch. Bot. Ges. 35 (1917) 341, t. 1; Bot. Jahrb. 72 (1942) 187, excl. spec. cit.; Hutch., Phylog. Flow. Pl. (1969) t. 342; P.F. Stevens, Contrib. Herb. Austral. 11 (1975) 28; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 331, t. 3; Fisher & Rutishauser, Can. J. Bot. 68 (1990) 2320.

Tree to 8 m; bole to 7 cm diam., sparsely branched. Bark greyish brown, scarcely cracking, cicatrose; inner bark claret. Leafy *twigs* to 4 mm diam. *Leaves* to 2 m long and to 28-jugate; petiole 5–10 cm, to 3.5(–6.5) mm diam., terete, with cicatrices of spent inflorescences. *Leaflets* 5–14.5(–22) by 3.2–5.5 (–7) cm, ovate to lanceolate or elliptic, pubescent on veins adaxially and abaxially, where sometimes whole surface thus, bases cuneate, apices acuminate; costae c. 14 on each side, venation weakly sunken adaxially, prominent abaxially; petiolules to 6 mm long. *Inflorescences* to 5 cm long, borne on concurrently flushing rachis, *Cymbopogon*-scented. *Calyx* c. 3.5 mm long, cupulate, sericeous, margin ± entire. *Petals* (3 or) 4, to 10 by 2 mm, creamy green, sparsely hairy without. *Staminal tube* c. 9 mm long, subglabrous or with retrorse hairs within except at top and bottom, margin obscurely lobed; anthers (4–) 6 or 7, locellate, inserted up to 3 mm within tube. *Ovary* 3- or 4-locular; style to 8 mm long, glabrous or with ascending hairs throughout most of its length. *Capsule* to 4 cm long, 2.5 cm diam., subovovoid to ellipsoid. *Seeds* unknown.

Distribution — *Malesia:* Papua New Guinea.

Habitat — Lowland and lower montane forest, 200–1770 m altitude.

15. Chisocheton lasiocarpus (Miq.) Valeton

Chisocheton lasiocarpus (Miq.) Valeton, Bull. Dép. Agr. Ind. Néerl. 10 (1907) 25; Steenis, Blumea 11 (1961) 132; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 15; in Handb. Fl. Papua New Guinea 1 (1978) 144; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 333, f. 1 (4). — *Dysoxylum lasiocarpum* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 13; C.DC. in DC., Monogr. Phan. 1 (1878) 527; Bull. Herb. Boiss. II, 3 (1903) 168. — *Alliaria lasiocarpa* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109.

Melioschinzia macrophylla K. Schum. in K. Schum. & Hollr., Fl. Kaiser Wilh. Land (1889) 62; Warb., Bot. Jahrb. 13 (1891) 343. — *Chisocheton macrophyllus* (K. Schum.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 295; in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1901) 381, non King (1895).

Chisocheton lauterbachii Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1901) 382; C.DC., Bull. Herb. Boiss. II, 3 (1903) 168.

Chisocheton pachyrachis Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1901) 382; C.DC., Bull. Herb. Boiss. II, 3 (1903) 169; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 314; Harms, Bot. Jahrb. 72 (1942) 187; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 27; in Handb. Fl. Papua New Guinea 1 (1978) 153.

Chisocheton novoguineensis C.DC., Bull. Herb. Boiss. II, 3 (1903) 169; Baker f., J. Bot. Lond. 61, Suppl. (1923) 8; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 25; in Handb. Fl. Papua New Guinea 1 (1978) 53.

Chisocheton forbesii C.DC., Bull. Herb. Boiss. II, 3 (1903) 168; Nova Guinea, Bot. 8 (1910) 424; Baker f., J. Bot. Lond. 61, Suppl. (1923) 8.

Chisocheton weiulandii Harms in K. Schum. & Laut., Nachtr. Fl. Deutsch. Schutzgeb. Südsee 3 (1905) 283; Merr. & L.M. Perry, J. Arnold Arbor. 29 (1948) 157; Hartley et al., Lloydia 36 (1973) 261; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 50; in Handb. Fl. Papua New Guinea 1 (1978) 171, t. 82; Johns, Comm. For. Trees Papua New Guinea 5 (1976) 213.

Chisocheton biroi Harms in K. Schum. & Laut., Nachtr. Fl. Deutsch. Schutzgeb. Südsee 3 (1905) 283; C.T. White, Proc. Roy. Soc. Queensl. 34 (1922) 38; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 53.

Chisocheton multijugis C.DC., Bull. Herb. Boiss. II. 3 (1903) 168, incl. var. *glabrior* C.DC.

Chisocheton schumannii C.DC., Nova Guinea, Bot. 8 (1910) 425; Harms, Bot. Jahrb. 72 (1942) 188; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 40; in Handb. Fl. Papua New Guinea 1 (1978) 164, t. 79; Johns, Comm. For. Trees Papua New Guinea 5 (1976) 216.

Chisocheton versteegii C.DC., Nova Guinea, Bot. 8 (1910) 424; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 49; in Handb. Fl. Papua New Guinea 1 (1978) 171.

Chisocheton frutescens C.DC., Nova Guinea 8 (1914) 1013.

Dasycoleum forbesii Baker f. & Norm., J. Bot. Lond. 61, Suppl. (1923) 8.

Chisocheton lamekotensis Harms, Notizbl. Bot. Gart. Berlin 10 (1928) 276; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 53.

[*Chisocheton lamii* Diels ex H.J. Lam, Nat. Tijds. Ned. Ind. 88 (1928) 216, nom. nud.; L.M. Perry, Sargentia 5 (1945) 59, nom. nud.]

Chisocheton sp. aff. *schumannii* C.DC.: C.T. White, J. Arnold Arbor. 10 (1929) 228.

Chisocheton myrmecophilus Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 313.

Chisocheton boridianus Harms, Bot. Jahrb. 72 (1942) 180.

Chisocheton eurycalyx Harms, Bot. Jahrb. 72 (1942) 182.

Chisocheton formicarum Harms, Bot. Jahrb. 72 (1942) 182; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 12; in Handb. Fl. Papua New Guinea 1 (1978) 141.

Chisocheton gjellerupii Harms, Bot. Jahrb. 72 (1942) 183.

Chisocheton caroli Harms, Bot. Jahrb. 72 (1942) 181; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 9; in Handb. Fl. Papua New Guinea 1 (1978) 137, t. 67.

Chisocheton trichocladus Harms, Bot. Jahrb. 72 (1942) 189; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 48; in Handb. Fl. Papua New Guinea 1 (1978) 170.

Chisocheton ledermannii Harms, Bot. Jahrb. 72 (1942) 184; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 53; in Handb. Fl. Papua New Guinea 1 (1978).

Chisocheton schlechteri Harms, Bot. Jahrb. 72 (1942) 188; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 37; in Handb. Fl. Papua New Guinea 1 (1978) 161, t. 77; Johns, Comm. For. Trees Papua New Guinea 5 (1976) 215.

?*Chisocheton oreophilus* Harms, Bot. Jahrb. 72 (1942) 185.

Chisocheton torricelliensis Harms, Bot. Jahrb. 72 (1942) 188; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 53.

Chisocheton sp.: Menninger, Flow. Trees (1962) t. 228.

Tree to 33 m; bole to 60 cm diam., fluted and with small buttresses to 1 m tall, when large. Bark blackish brown to red, sometimes cracking vertically and flaking; inner bark ± red; wood pinkish straw to white. Leafy *twigs* (2–)4–9 mm diam., cicatrose, sometimes myrmecophilous. *Leaves* to 150 cm; petiole 8–15 cm; rachis 2–4.5 mm diam., terete to ± winged or rarely ± flattened. *Leaflets* in up to 11 pairs, (7–)14–45 by (2.5–)7–23 cm, ovate to elliptic or suboblong, indumentum of adpressed hairs usually rather inconspicuous or puberulous on veins adaxially and/or velutinous abaxially, base occasionally subcordate, fine venation slightly prominent especially abaxially; petiolules 3–8 (–12) mm. *Inflorescences* to 60 cm, but usually less, axillary or on short shoots in defoliated axils of twigs to 2.5 cm diam., 0–2-branched, sweetly scented; branches to 20 cm; pedicels 0–5 mm. *Calyx* 2–4 mm long, margin truncate; pseudopedicel to 1.5 mm long. *Petals* (3) 4 or 5 (6), c. 7–16(–22) by 0.7–4.5 mm, white or flushed pink to claret, quincuncial, alternative or rarely imbricate. *Staminal tube* to 3 mm diam., pinkish, without glabrous or sparsely hairy in distal half, within retrorse hairy from (usually) just

below anthers to base, very rarely glabrous, margin truncate to shallowly lobed; anthers (3–)5–10(–18), c. 1–3 mm long, locellate, inserted about 2–4 mm within tube. *Ovary* (3-) 4- or 5- (6-)locular; style 6–15 mm, hairy at least at base. *Capsule* to 4 cm diam., obovoid to ± spherical, brownish red, hairs dense, sometimes of conspicuously different lengths; pericarp fibrous. *Seeds* up to 5; testa black, aril red surrounding hilum; cotyledons superposed. 2n = 92.

Distribution — Solomon Islands; *Malesia:* Moluccas (Ceram), New Guinea.

Habitat & Ecology — Primary or secondary forest including riparian and submontane, persisting in logged and grazed-through forest, to 1525 m altitude. According to Beehler [Auk 100 (1983) 1], the fruits of at least one form of this species ('*Chisocheton weinlandii*') are taken exclusively by birds of paradise, nine species of which visited a tree over its three-month fruiting season, during which it produced some 4500 fruits.

Uses — Leaflets used for wrapping sago and other food in cooking.

Variation — *Chisocheton lasiocarpus* comprises a complex of forms, which together may be described as an ochlospecies in that in any particular locality, there may appear to be distinct entities co-existing, but intermediates are found elsewhere, often co-existing with other apparently distinct entities, and so forth. Locally, nevertheless, it may be useful to recognize the major morphological entities, though there are many intermediates. The following key (after Stevens 1975) may be useful, though the very nature of this complex denies the possibility of pigeonholing every specimen:

KEY TO THE ENTITIES

1a. Leaf rachis prominently ridged or winged, adaxial surface flattened 2
b. Leaf rachis channelled to terete 3
2a. Inflorescence 3.5–12 cm long, flattened, petals 14–22 mm long ..... **e. 'pachyrhachis'**
b. Inflorescence c. 8–45 cm long, ± terete, petals 7.5–12 mm long ..... **a. 'novoguineensis'**
3a. Inflorescence to 8(–12) cm long, flowers dense; buds c. 4 mm across; indumentum never of long, erect hairs 4
b. Inflorescence usually more than 8 cm long; if less, flowers not dense, or buds c. 2 mm across or both 5
4a. Leaflets with dense ± crisped short hairs on midrib adaxially; anthers c. 3 mm long; style with hairs for most of its length ..... **c. 'lasiocarpus'**
b. Leaflets with, at most, adpressed hairs adaxially; anthers less than 2 mm long; style ± glabrous ..... **d. 'formicarum'**
5a. Leaflets with erect or crisped hairs at least adaxially on midrib 6
b. Leaflets adaxially with adpressed hairs, often appearing glabrous 8
6a. Leaflets without hairs abaxially; flowers always (?) 5-merous ... **g. 'versteegii'**
b. Leaflets with erect hairs abaxially 7
7a. Leaflet base shallowly cordate ..... **j. 'schlechteri'**
b. Leaflet base rounded to acute ..... **i. 'trichocladus'**

8a. Leaflets subcoriaceous; inflorescences less than 12 cm long, branches narrowly ascending, few-flowered ..... **f. 'caroli'**
b. Not this combination of characters 9
9a. No glabrous zone immediately below the anthers on inside of tube; flowers often 5-merous; calyx erect ..... **h. 'schumannii'**
b. Short glabrous zone immediately below anthers inside tube; flowers usually 4-merous; calyx usually ± spreading to suberect 10
10a. Style usually hairy for its entire length; fruit ovoid ..... **a. 'novoguineensis'**
b. Style glabrous at apex; fruits spherical ..... **b. 'weinlandii'**

a. 'novoguineensis'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 334. — *Chisocheton novoguineensis* C.DC. — *Chisocheton forbesii* C.DC. — *Chisocheton biroi* sensu C.T. White — *Dasycoleum forbesii* Baker f. & Norm. — *Chisocheton myrmecophilus* Merr. & L.M. Perry.

Central East New Guinea, hill or submontane rain forest, (100–)600–1525 m altitude.

b. 'weinlandii'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 334. — *Chisocheton weinlandii* Harms — *Chisocheton multijugis* C.DC. incl. var. *glabrior* C.DC. — *Chisocheton schumannii* auct. non C.DC.: C.DC. (1910), quoad spec. cit. — *Chisocheton frutescens* C.DC. — *Chisocheton sp.* aff. *schumannii* C.DC.: C.T. White — *Chisocheton boridianus* Harms — *Chisocheton eurycalyx* Harms.

Ceram, New Guinea, New Britain, primary and secondary rain forest to 1280 m altitude.

Note — This is a very widespread form but tends to be difficult to separate from '*novoguineensis*' on the one hand and, on the other, '*lasiocarpus*' and '*formicarum*' in its western range, as well as '*schumannii*' in the east and '*trichocladus*'. Intermediate specimens are cited by Mabberley (l.c. and see p. 315), one of them, between '*weinlandii*' and '*trichocladus*' being the type of *Chisocheton biroi* Harms.

c. 'lasiocarpus'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 335 — *Chisocheton lasiocarpus* (Miq.) Valeton, s.str. — *Dysoxylum lasiocarpum* Miq. — *Alliaria lasiocarpa* (Miq.) Kuntze.

Western New Guinea, rain forest at low altitudes.

d. 'formicarum'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 335. — *Chisocheton lamii* Diels ex H.J. Lam — *Chisocheton formicarum* Harms.

Northwest and central New Guinea, lowland rain forest.

Note — This is very similar indeed to some forms of '*pachyrachis*' and is connected by intermediates to '*schumannii*'.

e. 'pachyrhachis'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 335. — *Chisocheton pachyrhachis* Harms — *Chisocheton gjellerupii* Harms.

New Guinea, primary rain forest to 1000 m altitude.

f. 'caroli'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 336. — *Chisocheton caroli* Harms.

North-eastern New Guinea, primary rain forest to 1500 m altitude.

g. 'versteegii'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 336. — *Chisocheton versteegii* C.DC.

West New Guinea, known only from the type.

h. 'schumannii'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 336. — *Melioschinzia macrophylla* K.Schum. — ?*Chisocheton lauterbachii* Harms — *Chisocheton macrophyllus* (K.Schum.) Harms — *Chisocheton schumannii* Harms — ?*Chisocheton lamekotensis* Harms — ?*Chisocheton toricelliensis* Harms.

Northern New Guinea and (?) New Ireland, in lowland rain forest.

Notes — 1. It intergrades with '*trichocladus*' in the Solomons and is difficult to distinguish from '*weinlandii*' when in fruit.

2. Discovery of an isotype of *Chisocheton toricelliensis* (*Schlechter 4402*, BO) shows that it belongs in the *Chisocheton lasiocarpus* complex and possibly here.

i. 'trichocladus'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 336. — *Chisocheton trichocladus* Harms — *Chisocheton ledermannii* Harms.

Northern New Guinea to the Solomon Islands, primary or secondary rain forest, to 150 m altitude.

Note — This is linked to '*schlechteri*' by the type of *Chisocheton ledermannii* and other specimens as well as to '*schumannii*' and '*weinlandii*'.

j. 'schlechteri'

Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 337. — *Chisocheton schlechteri* Harms.

North-east New Guinea, primary rain forest.

Note — *NGF 21573* from Morobe Province is a leptocaul treelet less than 3 m tall. The flowers are similar to those of the more glabrous forms of '*weinlandii*', but the inflorescence is 3-branched, the major branches being up to 16 cm long. In some respects it approaches the description of *Chisocheton oreophilus* Harms, which probably belongs in this complex, but has a smaller calyx and may be referable to a form of *Chisocheton sayeri*.

16. Chisocheton pilosus C.DC.

Chisocheton pilosus C.DC., Nova Guinea, Bot. 8 (1910) 423; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 337. — *Chisocheton sayeri* (C.DC.) P.F. Stevens var. *pilosus* (C.DC.) P.F. Stevens, Contr. Herb. Austral. 11 (1975) 36; in Handb. Fl. Papua New Guinea 1 (1978).

Treelet 2.5 m tall. *Leaves* at least 25 cm; petiole c. 10 cm; rachis terete. *Leaflets* in up to at least 3 pairs, to 26 by 8 cm, oblong-ovate, glabrous adaxially, pilose abaxially, base cuneate, apex (?) acuminate, costae c. 13 on each side; petiolules c. 5 mm. *Inflorescence* to 12 cm, weakly paniculiform, axillary; branches to 3 cm long, pilose; bracts linear, pubescent; pedicels very short. *Calyx* campanulate, pubescent, margin truncate. *Petals* 4, c. 11.5 by 1.5 mm, puberulous without. *Staminal tube* villous within, margin truncate; anthers 6–8, c. 1.5 mm long, alocellate. *Ovary* and *female flowers* unknown.

Distribution — *Malesia:* West New Guinea, collected once (a hybrid with *C. sayeri*?).

17. Chisocheton sayeri (C.DC.) P.F. Stevens

Chisocheton sayeri (C.DC.) P.F. Stevens, Contr. Herb. Austral. 11 (1975) 32, excl. var. *pilosus* (C.DC.) P.F. Stevens; in Handb. Fl. Papua New Guinea 1 (1978) 158, t. 76, excl. var. *pilosus*; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 337. — *Dasycoleum sayeri* C.DC., Bull. Herb. Boiss. II, 3 (1903) 170.

Chisocheton erythrocarpus auct. non Hiern: Lane-Poole, Rep. For. Res. Papua New Guinea (1925) 100.

Chisocheton archboldianus Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 312.

Chisocheton erythranthus Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 312.

Chisocheton pohlianus auct. non Harms: Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 311.

Chisocheton acariianthus Harms, Bot. Jahrb. 72 (1942) 180 ('*acariaeanthus*').

Chisocheton graciliflorus Harms, Bot. Jahrb. 72 (1942) 183.

?*Chisocheton leptopetalus* Harms, Bot. Jahrb. 72 (1942) 184.

Chisocheton schumannii auct. non C.DC.: Hartley et al., Lloydia 36 (1973) 261.

Tree or treelet to 15 m; bole to 30 cm diam. Bark smooth or shallowly fissured, grey-green; inner bark pale brown. Leafy *twigs* to 3.5 mm diam. *Leaves* to 25(–75) cm; petiole 5–10 cm, 3.5 mm diam., terete. *Leaflets* in up to 9(–12) pairs, (5–)7.5–20(–43) by (2.5–)3.5–6.5(–9) cm, ovate to narrowly elliptic or lanceolate, subglabrous to velutinous on main veins adaxially and over whole abaxial surface; costae c. 9 on each side. *Thyrses* to 70 cm long, but usually much shorter, axillary, not or 1-branched (female) or 1–2-branched (male), sweetly scented; branches to 15 cm, patent or ascending, sometimes with congested flowers; pedicels to 2.5 mm. *Calyx* 1–1.5 mm deep, reddish brown, obscurely lobed. *Petals* (3) 4 (5), 8–10 by 1–1.5 mm, pale cream, alternative to imbricate. *Staminal tube* pubescent without, glabrous to densely hairy within from just below anthers to base, white; anthers 4–6 (7), 0.7–1.2(–1.5) mm long, locellate or not, glabrous. *Ovary* 3–5-locular; style to 9.5 mm, densely hairy in lower 2/3. *Capsule* to 2.8 cm long, 2 cm diam., obovoid to ellipsoid, obscurely stipitate, golden brown when young; pericarp fibrous with hairs of conspicuously different lengths. *Seeds* 3; aril circumhilar; cotyledons collateral or superposed.

Distribution — *Malesia:* New Guinea.

Habitat — Lowland or submontane rain forest, to 1500(–1830) m altitude.

18. Chisocheton aenigmaticus Mabb.

Chisocheton aenigmaticus Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 338, f. 4.

Tree. Leafy *twigs* 8–14 mm diam., terete, lenticellate. *Leaves* to 78 cm, pseudogemmulate; petiole 3–8 cm. *Leaflets* in up to 13 pairs, to 24 by 5.5 cm, elliptic oblong, sparsely adpressed hairy on veins adaxially, more so abaxially, bases obtuse to subcordate; costae c. 10–14 on each side. *Thyrses* to 70 cm long, axillary or slightly supra-axillary, pyramidal, 3-branched; axis c. 6 mm diam.; most proximal branches to 25 cm long, ascending. *Flowers* subsessile. *Calyx* 2–2.5 mm deep, c. 3 mm diam., cupulate, shortly pubescent without, glabrous within, margin truncate or shallowly 4- or 5-lobed. *Petals* 5, 5–10 by 1.5 mm, narrowly spathulate, ± adpressed pilose without, glabrous within, quincuncial or alternative. *Staminal tube* with long adpressed hairs without, ± villous within, margin truncate or shallowly 5-lobed; anthers 5, c. 2.2 mm long, inserted within tube or weakly exserted, basifixed, locellate. *Style* with ascending hairs; stylehead cylindric-capitate. *Female flowers* and *fruits* unknown.

Distribution — *Malesia:* Sumatra, Simalur I.

Habitat & Ecology — Unknown.

19. Chisocheton celebicus Koord.

Chisocheton celebicus Koord., Meded. Lands Plant. 19 (1895/6) 385 & (1898) 636 ('*celebica*'); Suppl. Fl. NO Celebes 2 (1922) t. 42; 3 (1922) 22; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 340.
Chisocheton glomeratus auct. non Hiern: Koord., Meded. Lands Plantent. 19 (1895/6) 385; Koord.-Schum., Syst. Verz. 3, 1 (1914) 63.
Chisocheton sp. A: Koord.-Schum., Syst. Verz. 3, 1 (1914) 63.

Tree. Leafy *twigs* c. 8 mm diam. *Leaves* to at least 30 cm, pseudogemmulate; petiole 3–10 cm. *Leaflets* in up to at least 5 pairs, to 32 by 14 cm, ovate to elliptic-oblong, fulvous tomentose on venation adaxially and over whole abaxial surface, bases rounded, apices shortly and gradually acuminate, midrib sunken adaxially in sicco, costae in c. 19 subopposite pairs, tertiary venation distinct; petiolules to 8 mm long; pseudogemmula densely long fulvous tomentose. *Thyrse* to 85 cm long, 2-branched, supra-axillary; axis c. 3 mm diam., branches to 9 cm long, ± fulvous tomentose. *Calyx* c. 2.5–3.5 mm long, 2–3 mm diam., tubular, long-pubescent without, margin truncate. *Petals* 5, 12–14 by 1.8 mm, narrowly spathulate, glabrous, alternative. *Staminal tube* densely sericeous without, especially in more distal half, up to anthers, glabrous or very sparsely villous within, margin truncate; anthers 6, 1.2–1.5 mm, narrowly oblong, locellate, glabrous, basifixed, included. *Disk* conspicuous. *Style* terete, long sericeous; stylehead cylindric-capitate. *Fruits* unknown.

Distribution — *Malesia:* NE Celebes.

Habitat — 100–700 m altitude.

20. Chisocheton glirioides P.F. Stevens

Chisocheton glirioides P.F. Stevens, Contr. Herb. Austral. 11 (1975) 13, t. 1; in Handb. Fl. Papua New Guinea 1 (1978) 142, t. 69; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 340.

Tree to 21 m: bole to 25 cm diam. Bark dark grey to grey-brown; inner bark dark straw. Leafy *twigs* to 4.5 mm diam. *Leaves* to 35 cm long, pseudogemmulate; petiole 7–10 cm, to 3.5 mm diam., terete. *Leaflets* 10–18(–24) by 3.7–7 cm, ovate-elliptic, subglabrous with adpressed hairs on venation, particularly abaxially, base acute, apex acute to weakly acuminate, costae up to 13 on each side; petiolules to 6.5(–12.5) mm. *Thyrse* to 40 cm, axillary, subglabrous, 1(–?2)-branched; branches to 4 cm, patent; bracts to 1 mm long, narrowly triangular. *Calyx* c. 2 mm long, cupulate, sessile, pubescent without, glabrous within, margin truncate. *Petals* 4, 12 by 1.7 mm, red, pubescent without, glabrous within, alternative to imbricate. *Staminal tube* c. 11 mm long, white, sparsely hairy in the middle on both surfaces, margin truncate or shallowly lobed; anthers 6 or 7, c. 1.3 mm long, locellate, inserted c. 2.5 mm within the tube. *Ovary* 3- or 4-locular, c. 2 mm long (male flowers only known), style pubescent, stylehead c. 0.6 mm diam. *Capsule* c. 1.5 cm diam., spherical, shortly pubescent; pericarp fibrous. *Seeds* unknown.

Distribution — *Malesia:* Papua New Guinea: Central Prov.

Habitat — Lowland rain forest, to 240 m altitude.

21. **Chisocheton sapindinus** P.F. Stevens

Chisocheton sapindinus P.F. Stevens, Contr. Herb. Austral. 11 (1975) 29, t. 4; in Handb. Fl. Papua New Guinea 1 (1978) 156, t. 75; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 340.

Tree to 10 m, leptocaul, somewhat weeping, ± riparian; bole to 10 cm diam. Bark greyish, smooth to finely fissured, reddish within; inner bark straw, sometimes unpleasantly scented. Leafy *twigs* to 2 mm diam., thinly hairy when young, becoming glabrous, cicatrose. *Leaves* to 45 cm, with very small pseudogemmula; petiole 1–8 cm, 1–2 mm diam. *Leaflets* in up to 9 pairs, (4–)7.5–15.5 by (2–)3.3–6.3 cm, ovate to elliptic, glabrescent, coriaceous, bases acute to cuneate, ± asymmetric, apices acuminate, venation impressed adaxially in vivo, prominent on both sides in sicco, costae 5–10 on each side; petiolules to 10 mm. *Inflorescence* racemose to thyrsoid, to 60 cm, but usually very much less, unbranched in females, 0–2-branched in males; branches to 3 cm, patent, with scattered flowers, especially distally; bracts c. 1 mm long, subulate; pedicels to 2 mm long. *Calyx* 1.7–2.5 mm long, margin often with a split to 1 mm. *Petals* 4, c. 13.5 by 1 mm, though smaller in males, ligulate, white or pinkish green, glabrous or with a few hairs apically, alternative. *Staminal tube* glabrous, margin weakly lobed; anthers 4–6, c. 0.7 mm long, locellate, inserted c. 1.5 mm within tube, connective glabrous or thinly pubescent. *Style* pubescent in proximal half; stylehead c. 0.5 mm diam. *Capsule* to 6.5 cm long, 2.25 cm diam., glabrous, red; valves 3 or 4. *Seeds* 2–4, to 3 cm long, 1.8 cm wide, 1.1 cm thick, ellipsoid to boatshaped; aril circumhilar, red; testa black; cotyledons superposed.

Distribution — *Malesia:* very local in Papua New Guinea.

Habitat — Primary rain forest, to 760 m altitude.

Series Paniculati

Chisocheton sect. *Euchisocheton* § *Paniculati* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 295; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 341 (as series in sect. *Chisocheton*).
Chisocheton § *Tetrapetali* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 151.

Leaves pseudogemmulate, rarely imparipinnate or paripinnate. Inflorescences axillary, supra-axillary, cauliflorus, ramiflorous or borne on supra-axillary branches. Seeds arillate. White latex sometimes present in pith, pericarp etc. of some species.

22. Chisocheton laosensis Pellegr.

Chisocheton laosensis Pellegr., Bull. Soc. Bot. Fr. 91 (1945) 178; in Fl. Indo-Chine, Suppl. (1946) 694; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 341.

Tree to 20 m. All young parts densely fulvous tomentose. Leafy *twigs* 6–9 mm diam. *Leaves* to 50 cm, pseudogemmulate; petiole 5–8 cm. *Leaflets* in up to 8 pairs, to 22 by 10 cm, elliptic, coriaceous, glabrous adaxially save (usually) on venation, abaxially ± tawny pubescent, apex abruptly and shortly acuminate, acumen 6–8 mm, costae c. 13 on each side, arcuate, prominent adaxially, tertiary venation conspicuous; petiolules c. 1 cm long, velutinous-fulvous. *Inflorescences* on supra-axillary branches to 90 cm long, with reduced caducous leaves, the whole resembling a supra-axillary thyrse, each to 25 cm long, not or sparsely branched with congested cymules of flowers; bracts lanceolate. *Calyx* to 3 mm long, cupular, pubescent without, glabrous within, margin ± 4-lobed. *Petals* 4, 11–14 by 2.5 mm, linear-oblong, adpressed pubescent without, glabrous within, drying blackish, alternative to imbricate. *Staminal tube* glabrous except for a few hairs in notches of lobes without and towards base within, margin 7- or 8-crenulate or -lobed; anthers 6–8, oblong-elliptic, locellate, glabrous, included. *Disk* c. 1 mm tall, cylindrical, glabrous. *Ovary* apparently 2-locular; style filiform, papillose, pubescent in proximal half; stylehead subglobular, glabrous with an equatorial papillose band. *Capsule* to 3 cm long, 2.5 cm diam., rusty tomentose; valves 3 or 4. *Seeds* 1 or 2, c. 15 mm long, apparently arillate.

Distribution — *Malesia:* Moluccas (Halmahera ?and Ceram).

Habitat — Rain forest, to 600 m altitude.

Note — The name derives from the type specimen which was believed to have been collected in Laos (Mabberley, l.c.) but, besides it, no non-Moluccan material is known. How this confusion came about is unclear.

23. Chisocheton ruber Ridley

Chisocheton ruber Ridley, Bull. Misc. Info. Kew (1930) 365; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 342.

Tree to 15 m; bole to 20 cm diam., fluted. Bark smooth to weakly and irregularly flaking, greenish grey or reddish, with conspicuous inflorescence bosses, sometimes bearing leafy shoots, arranged ± spirally from ground level to 5 m; wood ivory. Leafy *twigs* c. 12–15 mm diam. *Leaves* to 1.5 m long, pseudogemmulate, subglabrous, in

terminal spirals; petiole 8–20 cm; rachis ± 3-ribbed. *Leaflets* in up to 15 pairs, to 42 by 10 cm, oblong, coriaceous, brilliant carmine when young and appearing in flushes of up to 11 pairs at once, very sparsely puberulous, bases subacute, asymmetric, apices acuminate, costae c. 12–14 on each side, tertiary venation conspicuous abaxially; petiolules c. 6 mm. *Inflorescences* to 10 cm long, not or once branched, sweetly-scented, borne on bosses which produce them over several seasons; rachis pubescent; pedicels 1–3 mm long, pubescent, minutely bracteolate. *Calyx* c. 4 mm long, cupular, rugose, pubescent, red; margin ± 4- or 5-lobed. *Petals* 5 or 6, 20–22 mm long, 4 mm wide at widest, 2.5 mm at narrowest, linear-oblong to spathulate, fleshy distally, pubescent without, imbricate to quincuncial. *Staminal tube* pubescent distally without, villous within, white, adnate to corolla at base, the margin shallowly 6–8-lobed, each lobe praemorse or irregularly 2- or 3-fid; anthers 8–10, 2 mm long, oblong, alocellate, yellow, sparsely hairy near connective, basifixed. *Disk* obscure. *Ovary* conical, 5-locular, appressed pubescent; style white, hairy in proximal 3/4 or throughout; stylehead to 1.8 mm diam., very shortly cylindrical to subdiscoid. *Capsule* to 5 cm long, 3 cm diam., top-shaped, 5-merous, glabrous, reddish; pericarp with white latex. *Seeds* unknown.

Distribution — *Malesia:* Borneo (Sarawak, 1st Division).

Habitat & Ecology — Restricted to limestone formations, 80–250 m altitude.

24. **Chisocheton sarawakanus** (C.DC.) Harms

Chisocheton sarawakanus (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 342; in Tree Fl. Malaya 4 (1989) 238. — *Dasycoleum sarawakanum* C.DC. in DC., Monogr. Phan. 1 (1878) 541.

Chisocheton laxiflorus King, J. As. Soc. Beng. 64, ii (1895) 33, p. maj. p.; Ridley, Fl. Malay Penins. 1 (1922) 390; Craib, Fl. Siam. Enum. 1 (1926) 253.

Chisocheton brachyanthus Merr., J. Str. Br. Roy. As. Soc. 86 (1922) 315; Univ. Calif. Publ. Bot. 15 (1929) 122; Meijer, Bot. News Bull. Sabah 8 (1967) 79.

Chisocheton spec. A: Meijer, Bot. News Bull. Sabah 8 (1967) 79.

Chisocheton glomeratus auct. non Hiern: Meijer, l.c.

Tree 5–20 m high; bole to 30 cm diam., fluted below, with small buttresses to 2 m tall. Bark fawn to chocolate, smooth to weakly flaking; inner bark brownish yellow; wood white to pale fawn. Innovations ± pale ferruginous pubescent. *Twigs* terete, dark brown, clenticellate, glabrous when leafless. Leafy twigs c. 5 mm diam., rarely myrmecophilous. *Leaves* to 2 m long, pseudogemmulate; petiole 5–12 cm; rachis brown, pubescent to ultimately glabrous. *Leaflets* in up to 26 pairs, flushing in up to 3 pairs at once, 8–29 by 4–8 cm, elliptic to elliptic-oblong, subcoriaceous, shiny and glabrous on both surfaces to ferruginous pubescent abaxially, particularly on veins, and on veins adaxially, bases slightly narrowed or rounded, sometimes asymmetric, apices rather abruptly caudate-acuminate with acumen to 2 cm; costae 10–14 on each side, spreading, depressed adaxially and prominent abaxially in sicco; petiolules c. 6 mm, pubescent. *Thyrses* to 50 cm, narrowly paniculiform or subspiciform, supra-axillary; primary branches few, squarrose, bearing few secondary branches of cymules, the sweetly scented flowers

usually borne in pairs, sessile. *Calyx* 2–3 mm long, c. 1.8 mm diam., cupular, glabrous to puberulous without, glabrous within, margin truncate to obscurely crenate. *Petals* 4, c. 12 by 1.8 mm, linear, white, drying black, puberulous without, glabrous within, apex obtuse, slightly concave. *Staminal tube* cylindric, c. 2 mm diam., somewhat appressed hairy distally, margin crenate; anthers (3–)4–6, 1–2 mm long, inserted just below rim, somewhat ciliate posteriorly. *Disk* absent. *Ovary* appressed pubescent; style pubescent proximally; stylehead subcapitate, c. 0.5 mm diam. *Infructescence* with branches to 6 cm with up to 8 fruits on each. *Capsule* c. 4 cm diam., depressed globose, shortly stipitate, crimson, obovoid and densely ferruginous pubescent when young; pericarp sometimes with white latex. *Seeds* 2; testa dark brown, partly enveloped by aril.

Distribution — *Malesia:* Malay Peninsula, Bangka, Borneo.

Habitat — Rain forest, to 250 m altitude.

Note — There is a complete gradation between ± glabrous and hairy forms, the latter being readily distinguished from hairy forms of *Chisocheton patens* in Borneo, where they occur together, by their prominent leaf venation. Elsewhere, however, sterile material of these two species is often very difficult to separate.

25. **Chisocheton lasiogynus** Boerl. & Koord.

Chisocheton lasiogynus Boerl. & Koord. in Koord.-Schum., Syst. Verz. 2 (1910) 26; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 343.

Treelet to 2 m. Leafy *twigs* 4–5 mm diam. *Leaves* 50–68 cm, imparipinnate, 3–5-jugate, subglabrous, drying pale brown; petioles 8–12 cm. *Leaflets* to 12 by 5 cm, oblong to elliptic-ovate, sometimes subcrenulate opposite to subopposite, base cuneate, apex acuminate with acumen to 17 mm, costae c. 9 or 10 on each side, venation impressed adaxially, prominent abaxially. *Raceme* to 24 cm, bracteate, flowers aggregated near tip. *Calyx* 4.5–5 mm long, 4–4.5 mm diam., cupular to cylindrical, pubescent, margin truncate to obscurely lobed. *Petals* 4 or 5, 17 by 3 mm, creamy-white to pinkish or crimson, glabrous to sparsely pubescent proximally without. *Staminal tube* slightly expanded at mouth, white, densely pubescent in distal half, margin truncate to weakly crenulate; anthers 5–8, 1.5–2 mm long, narrowly oblong to boat-shaped, scarcely locellate, glabrous, basifixed, inserted. *Ovary* conical, 3-locular, densely hairy; style terete, sparsely pubescent in proximal half; stylehead subcylindrical, strongly exserted. *Infructescences* ramiflorous, sometimes apparently borne on reduced shoots, with fruits crowded at apex. *Capsule* strongly rostrate when immature, 2.5 cm long, subglobose-pyriform and red when mature. *Seeds* unknown.

Distribution — *Malesia:* Sumatra and (?) Java but not seen in the latter for a century.

Habitat & Ecology — Undergrowth treelet in rain forest, 40–450 m altitude.

Note — The Java records are collections by Forbes and Junghuhn and may have come from Sumatra (Mabberley, op. cit. 344). Specimens from northern Sumatra (Aceh) are more pubescent and have rather larger flowers than do specimens from elsewhere.

26. Chisocheton amabilis (Miq.) C.DC.

Chisocheton amabilis (Miq.) C.DC. in DC., Monogr. Phan. 1 (1878) 537; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 198; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 344; in Tree Fl. Malaya 4 (1989) 234. — *Schizochiton amabile* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1968) 26, 27, incl. var. *sumatranum* Miq.
Chisocheton illustris Ridley, Bull. Misc. Info. Kew (1930) 366.
Chisocheton hackenbergii Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 476.
Chisocheton brachyanthus auct. non Merr.: Anderson, Gard. Bull. Sing. 20 (1963) 115.

Tree 6–17 m; bole to 10 cm diam. Bark smooth to finely cracked or pustulate, grey-green; underbark orange-red to pinkish; inner bark cream, wood white. Leafy *twigs* 3–7 mm diam., elenticellate, reddish in sicco. *Leaves* 20–95 cm, pseudogemmulate; petiole 5–15 cm; rachis terete or laterally channelled in sicco; pseudogemmula fulvous tomentose. *Leaflets* in (4–)7–20 pairs, most proximal 2.2–11.5 by 1.9–4.8 cm, regularly elliptic, most distal 7.5–25.5 by 2.4–8.5 cm, elliptic-oblong, ± asymmetric, coriaceous, shiny adaxially, duller abaxially, glabrous on both sides, or midrib brown-tomentose adaxially and/or venation pubescent abaxially, bases subequally acute to obtuse, apices long-cuspidate, costae 5–14 on each side, ascending, prominulous to prominent abaxially, petiolules 2–5 mm long. *Thyrses* 8–45 cm, pendent, fragrant, borne in axils of youngest leaves, thus sometimes appearing terminal, often supra-axillary; axis glabrous to weakly pubescent, 3–5 mm diam., 1–2-branched with pubescent pedicels articulated on slender branchlets c. 3–4 mm long arising from first-order branches to 9 cm long in male, unbranched, spiciform and minutely pedunculate with subsessile flowers condensed into short dense cymules, mostly at distal end of rachis in female. *Calyx* 3–4 mm long, cupular, 4- or 5-lobed, subglabrous to weakly pubescent, green. *Petals* 5 or 6, 15–25 by 2–3 mm, narrowly obovate, white or sometimes also tipped pink, sparsely hairy without or glabrous, drying reddish, alternative to quincuncial. *Staminal tube* subglabrous to villous without, especially at base of lobes, villous within especially near base, margin 5–7-lobed, the lobes subentire to irregularly 2–3-fid; anthers 8–10, c. 1.5 mm long, scarcely locellate, long-pubescent dorsally, included within lobes. *Disk* c. 0.5–1 mm tall, subtubular, thick. *Ovary* 4-loculate; style pubescent, particularly in proximal half; stylehead subcylindric to spherical. *Infructescences* borne on leafy twigs to 8 mm diam. *Capsules* c. 4 cm diam., spherical, long-stipitate, glabrous, pink ripening to bright rose-red, clustered in groups of 3–10 at end of rachis; stipe 1.7–2.2 cm; valves 3 or 4. *Seeds* 3 or 4, c. 9 mm long, with chestnut brown testa half covered in circumhilar yellow-orange aril.

Distribution — *Malesia:* Sumatra, Malay Peninsula, Biliton, Borneo.

Habitat & Ecology — Peat swamp forest and riparian forest (as at Sg. Sedili, Johore, Malay Peninsula, where it is a common tree), 0–20 m altitude. According to Corner (op. cit. 30, 198) it flowers gregariously in April–May at Sg. Sedili, where it is restricted to the mempisang (*Polyalthia sclerophylla* Hook. f. & Thoms.) belt.

Note — Specimens with inflorescences borne on reduced axillary branches are known from southern Borneo.

27. Chisocheton cumingianus (C.DC.) Harms

Chisocheton cumingianus (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Merr., Philipp. J. Sc. 1, Suppl. (1906) 72; West & Brown, Bull. Philipp. Dept. Agr. For. 20 (1920) 117, cum tab.; ibid. 22 (1921) 119; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 367; Briq., Mém. Inst. Nat. Genev. 24 (1935) 67; Elmer, Leafl. Philipp. Bot. 9 (1937) 3346; Mabb., Taxon 26 (1977) 528, incl. subsp. *balansae* (C.DC.) Mabb.; Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 347, incl. subsp. *balansae* & subsp. *kinabaluensis* (Merr.) Mabb.; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 335, t. 255; Hô, Ill. Fl. Vietnam 2, 1 (1992) 494, incl. subsp. *balansae*. — *Dasycoleum cumingianum* C.DC. in DC., Monogr. Phan. 1 (1878) 541; Fern.-Vill., Nov. App. (1880) 42; Vidal, Phan. Cuming. (1885) 84; Rev. Pl. Vasc. Filip. (1886) 84.

Guarea gobara Buch.-Ham., Mem. Wern. Soc. 6 (1832) 306, p.min.p.; Wall., Cat. (1831/2) n. 4885, p.p.

Guarea paniculata Roxb., Hort. Beng. (1814) 28, nom. nud.; Fl. Ind., ed. Carey 1 (14 Jan 1832) 242; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 241; Wight, Ic. (1839) n. 146 (*'Guaria'*); Walp., Rep. 1 (1842) 435, non Buch.-Ham. (1 Jan. 1832). — [*Dysoxylum paniculatum* Arn. ex Wight, Ic. (1839) sub n. 146, nom. in syn.] — *Chisocheton paniculatus* Hiern in Hook. f., Fl. Brit. India 1 (1875) 552, nom. superfl.; C.DC. in DC., Monogr. Phan. 1 (1878) 531; Gamble, Trees Beng., ed. 2 (1896) 16; Prain, Beng. Pl. 1 (1903) 315; Brandis, Indian Trees (1906) 139, 703; Pellegr. in Fl. Indo-Chine 1 (1911) 736; ibid. Suppl. (1946) 692; Cowan & Cowan, Trees N Bengal (1929) 32; Kanj. et al., Fl. Assam 1, 2 (1936) 692; Chun, Sunyatsenia 4 (1940) 237; How & Chen, Acta Phytotax. Sin. 4 (1955) 18. — *Schizochiton paniculatum* (Hiern) Kurz, J. As. Soc. Beng. 44, ii (1875) 145; For. Fl. Burma (1877) 216.

Dysoxylum multijugum Arn. in Wight & Arn., Prodr. (1834) 121; Steud., Nomencl., ed. 2, 1 (1840) 534; Voigt, Hort. Suburb. Calc. (1845) 135; M. Roem., Synops. Monogr. 1 (1846) 101; Drury, Handb. Ind. Fl. 1 (1864) 168.

Cupania sp.: Wall., Cat. (1847) n. 4884B.

Chisocheton balansae C.DC., Bull. Herb. Boiss. 2 (1894) 578; Pellegr. in Fl. Indo-Chine 1 (1911) 737, t. 81, f. 12–15; Lecomte, Bois Indoch. (1925) 134.

Chisocheton coriaceus Pierre, Fl. For. Cochinch. 5 (1897) t. 346A; Pellegr. in Fl. Indo-Chine 1 (1911) 737.

Chisocheton thorelii Pierre, Fl. For. Cochinch. 5 (1897) sub t. 347; Pellegr. in Fl. Indo-Chine 1 (1911) 740 & Suppl. (1946) 696; Hô, Ill. Fl. Vietnam 2, 1 (1992) 495.

Chisocheton cochinchinensis Pierre, Fl. For. Cochinch. 5 (1897) t. 356B; Pellegr. in Fl. Indo-Chine 1 (1911) 739; Hô, Ill. Fl. Vietnam 2, 1 (1992) 494.

Chisocheton harmandianus Pierre, Fl. For. Cochinch. 5 (1897) t. 347; Pellegr. in Fl. Indo-Chine 1 (1911) 740.

Chisocheton amboinensis Valeton in Hochr., Pl. Bogor. Exsicc. (1904) 67; Briq., Mém. Inst. Nat. Genev. 24 (1935) 66.

Chisocheton chinensis Merr., Philipp. J. Sc. 21 (1922) 497.

Chisocheton kinabaluensis Merr., J. Str. Br. Roy. As. Soc. 86 (1922) 316.

Chisocheton sp.: Lane-Poole, Rep. For. Res. Terr. Papua New Guinea (1925) 100.

Chisocheton siamensis Craib, Bull. Misc. Info. Kew (1926) 342; Fl. Siam. Enum. 1 (1926) 253; Pellegr. in Fl. Indo-Chine, Suppl. (1946) 692.

[*Chisocheton benguetensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 3343, nom. non rite publ.]

[*Dysoxylum sorsogonense* Elmer, Leafl. Philipp. Bot. (1937) 3378, nom. non rite publ.]

Chisocheton morobeanus Harms, Bot. Jahrb. 72 (1942) 185; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 21; in Handb. Fl. Papua New Guinea 1 (1978) 147, t. 72; Johns, Comm. For. Trees Papua New Guinea 5 (1976) 214.

Chisocheton cf. *pachyrhachis*: Hartley et al., Lloydia 36 (1973) 261.

Tree to 37 m; bole to 14 m, 150 cm diam.; buttresses to 3 m tall, 2 m out or bole fluted to 10 m. Bark scaly, pale grey-brown; inner bark chestnut brown; sapwood straw. Limbs with conspicuous cicatrices. Leafy *twigs* 5–7 mm diam., dark brownish black,

Fig. 24. *Chisocheton cumingianus* (C.DC.) Harms. Flowering shoot. Papua New Guinea, Gogol Valley (*Mabberley 1757*). Photograph D.J. Mabberley, June 1974.

smooth but conspicuously lenticellate, sometimes with white latex, rarely myrmecophilous (and then sometimes the ant chamber housing scale insects, e.g. *Coode 5454* in K). Innovations ± rusty pubescent. *Leaves* to 120 cm, pseudogemmulate, crowded in dense terminal spirals; petiole 5–10 cm, 2.5–5 mm diam., terete or weakly flattened adaxially. *Leaflets* in up to 15 pairs, opposite or subopposite (proximally), (6–)10–42 by (2–)5–14 cm, ovate to elliptic, papery to coriaceous, drying red-brown, glabrescent or hispid pubescent on the costae adaxially or, exceptionally, softly velutinous, bases asymmetric, acute, apices shortly cuspidate, costae 10–15 on each side, ascending, arcuate, ± prominent abaxially, tertiary venation prominulous; petiolules (4–)6–12 mm, glabrescent to tawny tomentose. *Thyrses* to 50 cm, axillary, supra-axillary or borne on short shoots (3–8 thyrses per shoot) on defoliated twigs, branches or bole (Borneo), 2–3-branched; branches to 10 cm long, ± pubescent; pedicels to 3(–4) mm; bracteoles 2 mm long, linear; pseudopedicel to 1 mm long. *Calyx* 1–3 mm deep, campanulate, puberulous without, margin ± entire. *Petals* (3) 4 (5), 12–20(–25) by 2.5 mm, spathulate, acute, pale yellow to white, reddish in sicco. *Staminal tube* c. 1 mm diam., ± glabrous without, ± pubescent within from just below anthers to base, margin 6–9-lobed, lobes to 2.5 mm long, entire to 2- or 3-fid; anthers 6–9, 1.5–2.2 mm long, elliptic-oblong, locellate, glabrous to villous. *Disk* to 0.5 mm tall, annular, glabrous. *Ovary* in female (? and hermaphrodite) flowers 3- or 4-locular, each locule with 1 (2) ovule(s); style pubescent in proximal 3/4; stylehead disciform to capitate. *Infructescence* to 30 cm, pendent. *Capsule* to 7 cm diam., globose to pyriform, occasionally weakly rostrate, orange-red, gla-

brous to velutinous; stipe to 1.5 cm long; pericarp usually with white latex. *Seeds* 3 or 4; testa blackish brown; aril circumhilar, margin crenate, sometimes with extension to micropyle, orange-red; cotyledons superposed. 2n = 46, 92. — **Fig. 24.**

Distribution — Continental Asia from Assam and tropical China through Indochina to eastern *Malesia:* Philippines, Celebes, Moluccas (Ambon, Ternate), New Guinea, Bismarck Archipelago (Manus, New Britain, New Ireland).

Habitat — Rain forest, to 1300 m altitude.

Uses — The wood of Indian specimens has been considered by the timber industry. In New Guinea used as a fish poison.

Subdivision — Three subspecies are recognized, two of them occurring in and endemic to Malesia. The third one, restricted to the Asiatic mainland, is subsp. *balansae* (C.DC.) Mabb. [*Chisocheton balansae* C.DC., *Guarea paniculata* Roxb., *Dysoxylum multijugum* Arn., *Chisocheton paniculatus* Hiern, *Schizochiton paniculatum* (Hiern) Kurz, *C. coriaceus* Pierre, *C. thorelii* Pierre, *C. cochinchinensis* Pierre, *C. harmandianus* Pierre, *C. chinensis* Merr., *C. siamensis* Craib]. It usually has rather pubescent leaves and axillary or supra-axillary thyrses, while 2n = 46.

KEY TO MALESIAN SUBSPECIES

1a. Inflorescences borne on supra-axillary or ramiflorous short shoots, rarely supra-axillary and simple ..... **a.** subsp. **cumingianus**

b. Inflorescences borne on bole ..... **b.** subsp. **kinabaluensis**

a. subsp. **cumingianus**

Chisocheton cumingianus (C.DC.) Harms subsp. *cumingianus*; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 348. — *Dasycoleum cumingianum* C.DC. — *Chisocheton cumingianus* (C.DC.) Harms, s.str. — *Chisocheton amboinensis* Valeton — *Chisocheton sp.*: Lane-Poole — *Chisocheton benguetensis* Elmer — *Dysoxylum sorsogonense* Elmer — *Chisocheton morobeanus* Harms — *Chisocheton* cf. *pachyrhachis*: Hartley et al.

Distribution — Malesian distribution as for species except Borneo.

Vernacular name — Official common name in Philippines: balukanag.

Note — There is a distinct trend from axillary inflorescences in the north-west (Philippines) to reduced branches bearing inflorescences in defoliated twigs in the southeast, though there are exceptions. 2n = 92.

b. subsp. **kinabaluensis** (Merr.) Mabb.

Chisocheton cumingianus (C.DC.) Harms subsp. *kinabaluensis* (Merr.) Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 349. — *Chisocheton kinabaluensis* Merr.

Distribution — Mountains of northern Borneo: Kinabalu, Trusmadi.

Note — The inflorescences are always borne on the bole, often very close to the ground indeed. It is noteworthy that, contrary to general expectation, it is the high altitude taxon which is the truly cauliflorous one in this species.

28. Chisocheton patens Blume

Chisocheton patens Blume, Bijdr. (1825) 169; Schultes & Schultes, Syst. Veg. 7 (1829) 83; (1830) 1626; G.Don, Gen. Syst. 1 (1831) 685; Miq., Fl. Ind. Bat. 1, 2 (1859) 537; C.DC. in DC., Monogr. Phan. 1 (1878) 529, t. 7, f. 5; King, J. As. Soc. Beng. 64, ii (1895) 34; Koord., Minah. (1898) 385; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 591; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 350; in Tree Fl. Malaya 4 (1989) 235. — *Schizochiton patens* (Blume) Spreng., Syst. Veg. 4 (1827) 251; Walp., Rep. 1 (1842) 429 ('*Schizogiton*') in ind.; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27, 29; M.Roem., Synops. Monogr. 1 (1846) 102.

Chisocheton divergens Blume, Bijdr. (1825) 169; Schultes & Schultes, Syst. Veg. 7 (1829) 83; (1830) 1627; G.Don, Gen. Syst. 1 (1831) 685; Miq., Fl. Ind. Bat. 1, 2 (1859) 537; C.DC. in DC., Monogr. Phan. 1 (1878) 528; Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 22; King, J. As. Soc. Beng. 64, ii (1895) 35; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 292, t. 162, f. H; ibid., ed. 2, 19b1 (1940) 139, t. 30, f. h; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 99; Valeton in Hochr., Pl. Bogor. Exsicc. (1904) 68, incl. var. *genuinus* Valeton, var. *minor* Valeton, var. *robustus* Valeton; Brandis, Indian Trees (1906) 139; Backer, Schoolfl. Java (1911) 208; Koord., Exk. Fl. Java 2 (1912) 443; Craib, Aberd. Univ. Stud. 57 (1912) 36, incl. var. *robustus* Valeton; Koord., Atlas (1913) t. 165; Schmidt, Bot. Tidsskr. 32 (1916) 328, incl. var. *robustus* Valeton; Ridley, Fl. Malay Penins. 1 (1922) 390, incl. var. *patens* (Blume) Ridley, nom. illeg.; Briq., Mém. Inst. Nat. Genev. 24 (1935) 64; Backer & Bakh.f., Fl. Java 2 (1965) 124; T.D.Penn., Blumea 22 (1975) 496, t. 12, f. c & d; Corner, Seeds Dicots 2 (1976) & 2 (1976) t. 383 left. — *Schizochiton divergens* (Blume) Spreng., Syst. Veg. 4 (1827) 251; Walp., Rep. 1 (1842) 429; M.Roem., Synops. Monogr. 1 (1846) 102; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 26, 28.

[*Trichilia longissima* Wall., Cat. (1847) n. 8069, nom. nud.]

Cupania sp.: Wall., Cat. (1847) n. 8069.

Schizochiton ?: Wall., Cat. (1847) n. 9040.

Schizochiton tetrapetalum Turcz., Bull. Soc. Nat. Mosc. 1 (1858) 411. — *Chisocheton tetrapetalus* (Turcz.) C.DC. in DC., Monogr. Phan. 1 (1878) 530; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 368; Briq., Mém. Inst. Nat. Genev. 24 (1935) 65; Elmer, Leafl. Philipp. Bot. 9 (1937) 3347.

[*Melia pendula* Reinw. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 29, nom. in syn.]

[*Trichilia hexandra* Blume ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 29, nom. in syn.]

Chisocheton fragrans Hiern in Hook.f., Fl. Brit. India 1 (1875) 551; C.DC. in DC., Monogr. Phan. 1 (1878) 529.

Chisocheton glomeratus Hiern in Hook.f., Fl. Brit. India 1 (1875) 551 ; C.DC. in DC., Monogr. Phan. 1 (1878) 532; Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 22; King, J. As. Soc. Beng. 64, ii (1895) 30; Ridley, Fl. Malay Penins. 1 (1922) 389; Briq., Mém. Inst. Nat. Genev. 24 (1935) 66; Hô, Ill. Fl. Vietnam 2, 1 (1992) 494.

Chisocheton holocalyx Hiern in Hook.f., Fl. Brit. India 1 (1875) 551; C.DC. in DC., Monogr. Phan. 1 (1878) 530.

Chisocheton vrieseanus C.DC. in DC., Monogr. Phan. 1 (1878) 536.

Chisocheton barbatus C. DC., l.c.

Chisocheton laxiflorus King, J. As. Soc. Beng. 64, ii (1895) 33, p.p.

Chisocheton fulvus Merr., Philipp. J. Sc., Bot. 3 (1908) 146; Enum. Philipp. Flow. Pl. 2 (1923) 367.

[*Chisocheton urdanetensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 368, nom. in syn.]

[*Chisocheton apoensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 368, nom. in syn.; Elmer, Leafl. Philipp. Bot. (1937) 3341, nom. non rite publ.]

Tree to 35 m, but often flowering when 2–3 m tall; bole to 20 m and 70 cm diam., sometimes fluted or buttressed, buttresses to 2 m tall, 1 m out and 8 cm thick, concave. Bark pale greenish to black, smooth to faintly cracked, lenticellate, the lenticels in horizontal rows (Pennington); inner bark pale to dark brown; wood pale to dirty cream, often smelling of methyl mercaptan. Leafy *shoots* c. 6 mm diam., glabrous to deciduously tomentose, bark dark, cicatrices conspicuous. *Leaves* to 70 cm, paripinnate to

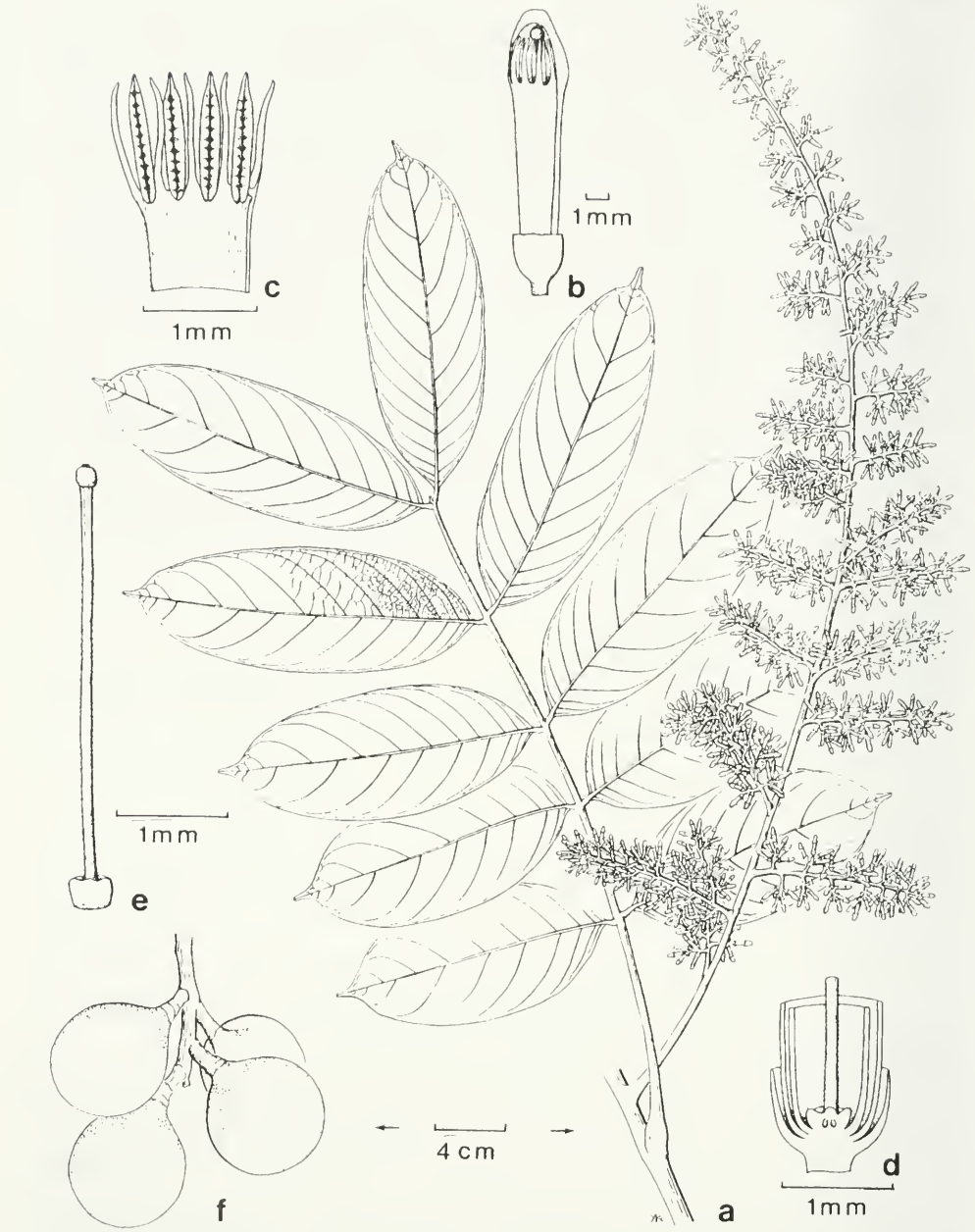

Fig. 25. *Chisocheton lansiifolius* Mabb. a. Leaf and inflorescence; b. flower; c. inside staminal tube; d. half flower base; e. pistil; f. fruits (*SAN 30737*). Drawing Yap Pak Hau. © The Natural History Museum, London. Bull. Brit. Mus. (Nat. Hist.), Series Botany, vol. 6 (4), 1979.

pseudogemmulate, in terminal bunches; petiole 7–15 cm, glabrous to pubescent. *Leaflets* 6–28 by 2.5–10.5 cm, narrowly oblong to oblong- or elliptic-lanceolate, opposite to subopposite, often maturing all together, thinly coriaceous, often conspicuously paler abaxially, base ± rounded or rarely subcordate, ± unequal, shortly acuminate, adaxial surface glabrous or with tomentose midrib and pubescent veins, abaxial surface glabrous or with tomentose midrib and pubescent veins, abaxial surface glabrous to softly tawny pubescent, midrib and veins tomentose, costae 9–14 on each side, ± prominent abaxially, tertiary venation often conspicuous; petiolules 3–6 mm. *Thyrse* to 90 cm, borne in upper axils or supra-axillary, pendent, paniculiform; most proximal branches to 17 cm (10 cm in females), ultimate branchlets cymules of subsessile or shortly pedicellate fragrant flowers; axes glabrous to tomentose; bracteoles minute. *Calyx* 2.5–3 mm, cupular to shortly tubular, puberulous, margin subentire to minutely, irregularly toothed. *Petals* 4, 5–10 mm long, subspathulate-elliptic, glabrous to glabrescent. *Staminal tube* 5–7(–8) mm, glabrescent or minutely pubescent near mouth without, pubescent, tomentellous or very rarely villous within, margin with (5–)6–8 linear-triangular lobes a little shorter than anthers; anthers (5) 6 or 7 (8), basifixed, glabrous, locellate. *Disk* absent or very short, fleshy, glabrous, ± lobed. *Ovary* pubescent; style glabrous to densely short pubescent; stylehead cylindric to clavate. *Capsule* to 5 cm long, 4.5 cm diam., subglobose, stipitate, glabrous to tomentose (especially when unripe), 2-locular; stipe to 2 cm. *Seeds* 2, 5–11 mm long, to 8 mm wide, scutiform, half covered by an aril.

Distribution — Peninsular Thailand; *Malesia:* Sumatra, Bangka, Malay Peninsula, Borneo, Java, Philippines, Celebes.

Habitat — Common in lowland rain forest, to 500 m altitude.

Notes — 1. This is an extremely variable species of which *Chisocheton lansiifolius* is a satellite. It cannot be satisfactorily subdivided throughout its range but in particular islands it may be possible and useful to recognize distinctive microtaxa. For example, in the Malay Peninsula, most herbarium specimens can be allotted to the almost glabrous *Chisocheton patens* s. str., the hairy ones to '*Chisocheton glomeratus*', and, in the Philippines they can be similarly divided between *Chisocheton patens* s. str. and '*Chisocheton fulvus*'. Even so, there are always a number of intermediates (Mabberley, l.c.). The variation pattern somewhat resembles that of *Chisocheton lasiocarpus* (q.v.) but is complicated by being spread over several islands and thus approaches the situation presented by *Vavaea amicorum* (q.v.).

2. Some specimens from Sarawak, particularly from Semengoh Forest Reserve near Kuching are curious for their large coriaceous leaflets, which resemble those of *Chisocheton lansiifolius*. These are treelets to 3 m tall and require further study (Mabberley, l.c.).

29. **Chisocheton lansiifolius** Mabb.

Chisocheton lansiifolius Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 352, t. 5.

Tree to 18 m; bole to 25 cm diam., sometimes fluted and buttressed, buttresses to 2 m tall, c. 5 cm wide, concave. Bark smooth, dark brown; inner bark yellow; sapwood

pale brown. *Twigs* dark brown, lenticellate, cicatrose. Leafy twigs c. 8 mm diam. *Leaves* to 54 cm long, paripinnate, ?pseudogemmulate, to 5-jugate; petiole 8–15 cm. *Leaflets* to 42 by 10.5 cm, oblong-elliptic or -ovate, coriaceous, subglabrous, bases acute to obtuse, apices acuminate, acumen to 18 mm, costae c. 14 on each side, arcuate, venation prominent on both surfaces in sicco; petiolule 6–11 mm, drying blackish. *Thyrse* to 65 cm long, paniculiform; proximal branches to 18 cm, squarrose, branched, these branches passing interceptibly, like the major branches on the main axis, into cymose fascicles of 1–6 flowers. *Calyx* c. 1.5 mm deep, cupulate, rugose, margin obscurely 4-lobed. *Petals* 4, 8–9 by 1.5 mm, weakly pubescent without, glabrous within, creamy white to pinkish, connate at the base. *Staminal tube* glabrous without, cottony pubescent within, margin 6-lobed, the lobes entire, lanceolate, c. 2 mm long; anthers 6, c. 2.5 mm long, glabrous, weakly locellate. *Disk* annular, thick. *Style* terete, pilose in proximal 3/4; stylehead subcylindrical. *Infructescence* to 85 cm long; axis c. 8 mm diam.; branches bearing 1 or 2 capsules. *Capsule* to 5 cm diam., subspherical, stipitate, red; valves 4. *Seeds* 2, scutiform, c. 3 cm diam. — **Fig. 25.**

Distribution — *Malesia:* north and eastern Borneo.

Habitat — Primary and secondary forest including peat swamp forest, to 100 m altitude.

30. **Chisocheton granatum** Mabb.

Chisocheton granatum Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 354, t. 6.

Tree to 12 m; bole to 8 m, 17 cm diam. *Twigs* cicatrose, lenticellate. Leafy twigs c. 6 mm diam. *Leaves* to 120 cm long, pseudogemmulate, in lax terminal spirals, ± pubescent; petioles 5–10 cm long. *Leaflets* to 24 by 7.5 cm, in up to 12 pairs, oblong to oblong-ovate, pale abaxially in sicco, bases cuneate, somewhat asymmetric, apices abruptly shortly acuminate, costae c. 22 on each side, weakly arcuate, almost reaching margin, prominent abaxially in sicco; petiolules 8–12 mm; pseudogemmula markedly circinnate. *Thyrse* to 25 cm long, supra-axillary, often borne in axils of unexpanded leaves; branches to 6 cm or short-stalked cymules (female). *Calyx* 2.5–3 mm, campanulate, pubescent, margin truncate. *Petals* 4, c. 12–16 by 3.5 mm, linear-spathulate, creamy white, pubescent without, imbricate, forming a clavate corolla in male. *Staminal tube* pubescent in distal half without, glabrous within, inflated near anthers, margin obscurely crenate or truncate; anthers 6, 1.5 mm long, oblong, locellate, glabrous. *Ovary* 5-locular; style pilose in proximal 3/4, stylehead shortly cylindrical, glabrous, apically lobed. *Capsule* to 9 cm diam., flattened globose; valves 5, glabrous, tough, red brown without, white within, without latex. *Seeds* 4 or 5, c. 3 cm long, scutiform (where 4) or like orange-segments (when 5); cotyledons with white latex.

Distribution — *Malesia:* Borneo (Mt Kinabalu area, and one sterile specimen from E Kalimantan).

Habitat — Hill forest, (?300–)900–1500 m altitude.

Note — This species is somewhat anomalous in this section in having exarillate seeds.

Section Holopentas

Chisocheton sect. *Holopentas* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27.
Dasycoleum Turcz. (genus). — *Chisocheton* sect. *Dasycoleum* (Turcz.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 354. — *Schizochiton* Spreng. sect. *Dasycoleum* (Turcz.) Kuntze in T. Post & Kuntze, Lex. Gen. Phan. (1903) 505.

Trees or treelets, pachycaul to slender leptocaul, usually with white latex. *Indumentum* of simple hairs. *Leaves* pseudogemmulate. *Inflorescences* axillary or supra-axillary. *Petals* in 1–2 whorls, imbricate to valvate. *Staminal tube* lobed or not, anthers glabrous, locellate. *Disk* obscure to shallowly cupulate. *Ovary* 2–9(–11)-locular. *Fruit* laticiferous. *Seeds* sarcotestal.

Distribution — 14 species, Indochina throughout *Malesia* to New Guinea.

Notes — 1. *Chisocheton macrophyllus* [and its ally *C. dysoxylifolius* (Kurz) Hiern from mainland Asia] is better placed in this section than in the last one, where it is found in Mabberley, op. cit. 344. Miquel's sectional name is employed here, as it is clear from his remarks under *Dysoxylum setosum* Miq. (op. cit. 14) that his § is meant to signify a section and is not rankless as hitherto held. (Type, here selected: *Chisocheton ceramicus*).

2. The section can be divided into two series, though *C. mendozae* and *C. grandiflorus* (Kurz) Hiern from Burma and Thailand are links.

KEY TO THE SERIES

1a. Corolla enclosing at least one petal, imbricate; tube weakly lobed or unlobed, stylehead discoid to subcapitate ..... Series **Pauciflori**
b. Petals valvate; tube conspicuously lobed; stylehead capitate ..... Series **Sandoricocarpi**

Series Pauciflori

Chisocheton sect. *Euchisocheton* § *Pauciflori* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 295; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 356 (as series in sect. *Chisocheton*).
[*Chisocheton* § *Grandiflori* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 151, nom. non rite publ.]

Corolla of 1–2 whorls, including at least one petal, imbricate. Staminal tube weakly lobed or truncate. Stylehead discoid to subcapitate.

Distribution — Six species from S Burma to Celebes, five endemic in *Malesia*.

31. **Chisocheton perakensis** (Hemsl.) Mabb.

Chisocheton perakensis (Hemsl.) Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 356; in Tree Fl. Malaya 4 (1989) 238. — *Megaphyllaea perakensis* Hemsl. in Hook., Ic. Pl. 18 (1887) t. 1708; King, J. As. Soc. Beng. 64, ii (1895) 24; Ridley, Fl. Malay Penins. 1 (1922) 386; Burkill & Hend., Gard. Bull. Str. Settl. 3 (1925) 356; T.D. Penn., Blumea 22 (1975) 496, t. 12c.
Chisocheton annulatus King, J. As. Soc. Beng. 64, ii (1895) 31. — *Megaphyllaea annulata* (King) Ridley, Fl. Malay Penins. 1 (1922) 386.

Pachycaul tree to 15 m; branching sparse and somewhat fastigiate. Leafy *twigs* c. 1 cm diam., with white latex. *Leaves* to 2 m long, at least 7-jugate, pseudogemmulate; petiole c. 10–25 cm, flattened adaxially, glabrous to pubescent, as is rachis. *Leaflets* to 38 by 10 cm, oblong to elliptic oblong, subcoriaceous, weakly asymmetric, bases cuneate; apices shortly acuminate, costae c. 10–14 on each side, rather oblique, prominent abaxially; petiolules to 15 mm. *Inflorescence* a raceme (female) or thyrse (male), to 75 cm, supra-axillary, pendent, puberulous; axis 4-angled, compressed in sicco; the proximal branches to 12 cm, few-flowered; pedicels 7–10 mm; flowers somewhat larger in females than males, sweetly-scented, laticiferous. *Calyx* c. 6 mm tall, 9 mm diam., campanulate to subcylindrical, extended into stout pseudopedicel c. 10 mm long, puberulous to rusty-tomentose without, with thickened wavy, median band, apex completely enclosing corolla in bud and splitting into c. 4 irregular triangular teeth c. 5 mm tall at anthesis. *Petals* in 2 ranks, 3 outer 14–24 by 7–8 mm, oblong-spathulate, fleshy, tomentellous without, glabrous within, apex rounded, (3–)4–7 outer 10–18 by 3–5 mm, narrowly oblong-spathulate, glabrous. *Staminal tube* 5–7 mm diam., glabrous without, sparsely pilose within, below anthers, margin obscurely crenulate to lobed, the lobes to 1 mm; anthers 10–13, c. 2.5 mm long, linear-oblong, locellate, glabrous, basifixed, included c. 1 mm within tube. *Disk* very shallow to obscure or absent. *Ovary* c. 9 mm long, 3 mm diam. (female), 7–9-locular; style terete, pubescent proximally; stylehead c. 1.5 mm diam., discoid, glabrous. *Capsule* c. 8 cm diam., flattened-globose, densely but minutely tomentose, borne singly or in pairs; pericarp thick, leathery, exuding white latex on cutting. *Seeds* c. 2.5 cm long, shaped like orange-segments, 1 per locule; hilum large; sarcotesta vascular; cotyledons superposed.

Distribution — *Malesia:* Malay Peninsula, restricted to Maxwell's Hill area.

Habitat — Hill forest, 900–1150 m altitude.

32. **Chisocheton sarasinorum** Harms

Chisocheton sarasinorum Harms in Fedde, Rep. 42 (1937) 8; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 356.

Pachycaul treelet or small tree to 15 m with open crown. Bark smooth greyish green, inner bark pale brown; wood pale fawn. *Twigs* rather rough, brown, with vertical lenticels. Leafy twigs c. 8 mm diam. *Leaves* to 150 cm, at least 7-jugate, pseudogemmulate, dull adaxially, pale abaxially, in terminal spirals; rachis green, subglabrous to weakly pilose; petiole to 20 cm or more, subglabrous to weakly pilose. *Leaflets* 10–28 by 3.5–10 cm, oblong or oblong-lanceolate, glabrous or subglabrous when sparsely pubescent on veins, bases acute or weakly obtuse, apices acuminate, costae c. 15 on each side, prominent and drying pale abaxially; petiolules to 15 mm, sometimes pubescent. *Thyrses* to 35 cm, axillary to supra-axillary, narrow, sparsely branched; most proximal branches to 14 cm, ascendant weakly pilose to subglabrous, each with 1–4 flowers; pedicels c. 2–3 mm, stout. *Calyx* 5–6 mm long, 7–8 mm diam., shallowly cupular, densely tomentose without; margin truncate to obscurely undulate. *Petals* (5) 6 in two ranks, white, adhering to tube at base, 3 outer 16–20 by 6 mm, narrowly oblong, ob-

tuse, (2) 3 inner 14–18 mm long, almost linear, obtuse, apices hooded. *Staminal tube* thick, tough, glabrous to subglabrous without, laxly pilose proximally within, margin truncate to obscurely dentate; anthers 8–10 (11), 2–2.5 mm long, linear, basifixed, included. *Ovary* 6–8-locular, densely villous; style villous in proximal half; stylehead discoid to stoutly cylindrical. *Capsule* to 7 cm long, 8 cm diam., flattened globose, 6–8-locular, borne singly or paired on rachis to 20 cm long, 8 mm diam.; pericarp c. 4 mm thick, tough, greenish-brown velutinous, exuding white latex on damage. *Seed* to 5 cm, like an orange-segment; sarcotesta vascularized.

Distribution — *Malesia:* NE Borneo and Celebes.

Habitat — Swampy forest and hill rain forest, sometimes disturbed, up to 1150 m altitude.

Note — The leaves closely resemble those of *Chisocheton ceramicus* and sterile material may be readily confused.

33. **Chisocheton pauciflorus** King

Chisocheton pauciflorus King, J. As. Soc. Beng. 64, ii (1895) 27; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 59; Fl. Malay Penins. 1 (1922) 387; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 357; in Tree Fl. Malaya 4 (1989) 237.

Leptocaul shrub to small tree 17 m tall; bole to 20 cm diam. Bark dark brown to reddish, smooth; inner bark, red; wood white. Leafy *twigs* c. 3 mm diam., puberulous, blackish in sicco. *Leaves* to 38 cm long and 5-jugate, pseudogemmulate; petiole 2–6 cm. *Leaflets* to 25 by 10 cm, but usually much smaller, oblanceolate or oblong-lanceolate to elliptic-ovate, glabrous, shiny adaxially, paler, glabrescent, reticulate, puberulous on veins abaxially, bases cuneate, apices shortly acuminate, costae 5–8 on each side, arcuate and slightly prominent abaxially; petiolules 2–4 mm. *Racemes* 2–13 cm, supraaxillary, puberulous, 1–6-flowered. *Flowers* c. 2 cm long, waxy and heavily scented; pedicel 6–12 mm, puberulous. *Calyx* c. 6 mm long, 6 mm diam., tubular, fleshy, tomentose without, margin truncate to obscurely 5-lobed, enveloping corolla in bud, accrescent in fruit. *Petals* (4) 5 or 6, white, waxy, in 2 ranks, 3 outer c. 18 by 6 mm, spathulate-elliptic, minutely tomentose without, glabrous within, (1) 2 or 3 inner c. 17 by 3–5 mm, narrowly spathulate-elliptic, glabrous save a longitudinal median band of minute tomentum in those flowers where inner rank is partly exposed through gaps between outer petals, all blunt and weakly overlapping at apices. *Staminal tube* glabrous, save sparse pubescence below anthers within, margin obscurely lobed; anthers (4–)8–10, c. 1.5 mm long, narrowly elliptic to linear, weakly locellate, glabrous, basifixed, included. *Disk* small, flat, tomentose. *Ovary* and style pubescent except for glabrous band below discoid to shortly cylindrical stylehead. *Capsule* at least 1 cm diam., spherical, when ripe ellipsoid, rostrate, tomentose and with persistent, usually accrescent calyx when young. *Seeds* unknown.

Distribution — *Malesia:* western and southern parts of Malay Peninsula, formerly (?) also in Singapore.

Habitat — Primary forest, to 550 m altitude.

34. Chisocheton diversifolius Miq.

Chisocheton diversifolius Miq., Fl. Ind. Bat., Suppl. (1861) 196, 504 ('*diversifolium*'); C.DC. in DC., Monogr. Phan. 1 (1878) 538; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 358. — *Schizochiton diversifolium* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27, 31.

Tree to 10 m tall. Leafy *twigs* 4–5 mm diam., drying blackish. *Leaves* to 47 cm, at least 11-jugate; petiole c. 5 cm, weakly pubescent. *Leaflets* alternate to subopposite proximally, opposite distally, to 15 by 4 cm, oblong-lanceolate, bases acute, apices acuminate, costae c. 12 on each side, prominulous in sicco; pseudogemmula minute. *Thyrses* c. 10 cm, subspiciform with short branches and cymules, in axils of young leaves; axes puberulent, bracts c. 1 mm, triangular, puberulent; pedicels c. 3–4 mm, puberulent. *Calyx* 3–5 mm long, obconical to campanulate, densely pubescent without, margin entire. *Petals* 4 or 5, 8 by 3 mm, linear-spathulate, two often narrower than the others, imbricate, white. *Staminal tube* 5- or 6-dentate, glabrous to very sparsely pubescent without, teeth retuse; anthers 5 or 6, 2 mm long, linear, locellate, glabrous, included. *Ovary* pubescent; style hirtellous; stylehead capitate to subdiscoid. *Fruits* unknown.

Distribution — *Malesia:* Sumatra (Lampongs, where it was rediscovered in 1968 by Jacobs; previously known only from Korthals's original gathering).

Habitat — Rain forest, c. 1200 m altitude.

Note — *Nagamasu 3575* (L) from the W slope of Barisan range E of Padang may belong here, though it is a tree 15 m tall with very broad leaflets and long inflorescences (25 cm) and pyriform fruit to 2 cm diam.

35. Chisocheton mendozae Hildebr.

Chisocheton mendozae Hildebr., Philipp. J. Sc. 91 (1963) 509 ('*mendozai*'); Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 359. — *Amoora fulva* Merr., Philipp. J. Sc., Bot. 11 (1916) 187; Enum. Philipp. Flow. Pl. 2 (1923) 370.

Tree c. 9 m tall; bole to 25 cm diam. Leafy *twigs* c. 9 mm diam. *Leaves* to at least 20 cm, with large densely tomentose pseudogemmula; petiole 7–8 cm. *Leaflets* in up to at least 3 pairs, to 20 by 9 cm, elliptic, base obtuse to rounded, apex acuminate, bright rusty tomentose when expanding, costae c. 12 on each side, tertiary venation conspicuous; petiolules 3–6 mm. *Thyrse* to 40 cm, markedly supra-axillary, twice-branched; branches to 6 cm long, fulvous pubescent; bracts c. 2 mm, triangular, fulvous pubescent; pedicels ± absent. *Calyx* c. 3.5 mm tall, cupulate, margin obscurely lobed to praemorse. *Petals* 5, c. 18 mm long, oblong spathulate, sericeous without, glabrous within, fleshy, 3 valvate, 1 ± enclosed, 1 enclosed. *Staminal tube* pilose without to halfway up lobes, pubescent within to just beneath anthers, margin 5-lobed, each lobe 3 mm long, entire; anthers 5, c. 3 mm long, narrowly oblong, locellate, subbasally attached. *Pistil* pubescent to just beneath subcylindrical stylehead 1 mm diam. *Capsule* and *seeds* unknown.

Distribution — *Malesia:* Philippines, known only from Samar.

Habitat — 'Forest edge', 220 m altitude.

Series Sandoricocarpi

Chisocheton sect. *Dasycoleum* (Turcz.) Harms series *Sandoricocarpi* Harms ex Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 359. — *Chisocheton* § *Sandoricarpi* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 153, nom. non rite publ.

Chisocheton § *Pauciflori* auct. non Harms (1896): Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 151.

Chisocheton § *Dasycolei* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 153.

Corolla of 1 whorl, imbricate or valvate. Staminal tube lobed. Stylehead subdiscoid to cylindrical.

Distribution — 7 species from Vietnam, Thailand and *Malesia* eastwards to the Bismarck Archipelago.

36. **Chisocheton vindictae** Mabb.

Chisocheton vindictae Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 359, f. 7.

Tree to 19 m tall; bole to 38 cm diam. Inner bark with white latex; wood creamy. Leafy *shoots* c. 12 mm diam. *Leaves* to 50 cm, pseudogemmulate and at least 6-jugate; petiole c. 10 cm, flattened to grooved adaxially, sulcate and swollen basally. *Leaflets* to 21 by 7.5 cm, elliptic-ovate, subglabrous to sparsely short pilose, bases cuneate to rounded, apices shortly acuminate, midrib deeply impressed adaxially in sicco, costae c. 11 on each side, ascending, prominent abaxially. *Thyrse* 20–105 cm, with a distal head of cymules (female) or branched, the branches rather few, to c. 25 cm long, subsquarrose, bearing short branches intergrading into sessile cymules of fragrant flowers, supra-axillary; axes subglabrous, main axis c. 5 mm diam.; bracts and bracteoles c. 1.5 mm long, triangular, densely pubescent; pedicels 0–1.5 mm, stout, pubescent, or absent; pseudopedicels c. 2 mm, densely pubescent. *Calyx* c. 4.5 mm long, 6.5 mm diam., shallowly cupulate, ± densely pubescent without, margin entire to obscurely lobed. *Petals* 6, 18–22 mm long, boat-shaped, fleshy, valvate, pubescent without, greyish green to dirty yellowish brown (De Wilde). *Staminal tube* densely pubescent on both sides, margin c. 7-lobed, each lobe c. 1.5 mm long, truncate to somewhat bilobed, sparsely pubescent; anthers 7, 3 mm long, locellate, weakly bilobed at each end, glabrous, basifixed. *Disk* c. 2 mm tall, stipitate. *Pistil* c. 11-ribbed, densely pubescent; style subglabrous, terete; stylehead c. 1.5 mm diam., subdiscoid with apical dimple. *Fruits* unknown. — **Fig. 26.**

Distribution — *Malesia:* Sumatra [Aceh and Bengkulu (*bb 15452*, BO)].

Habitat — Rain forest, c. 200–550 m altitude.

Note — This has been collected only three times and is very poorly known.

37. **Chisocheton macrophyllus** King

Chisocheton macrophyllus King, J. As. Soc. Beng. 64, ii (1895) 32; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 106; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 59; Backer, Schoolfl. Java (1911)

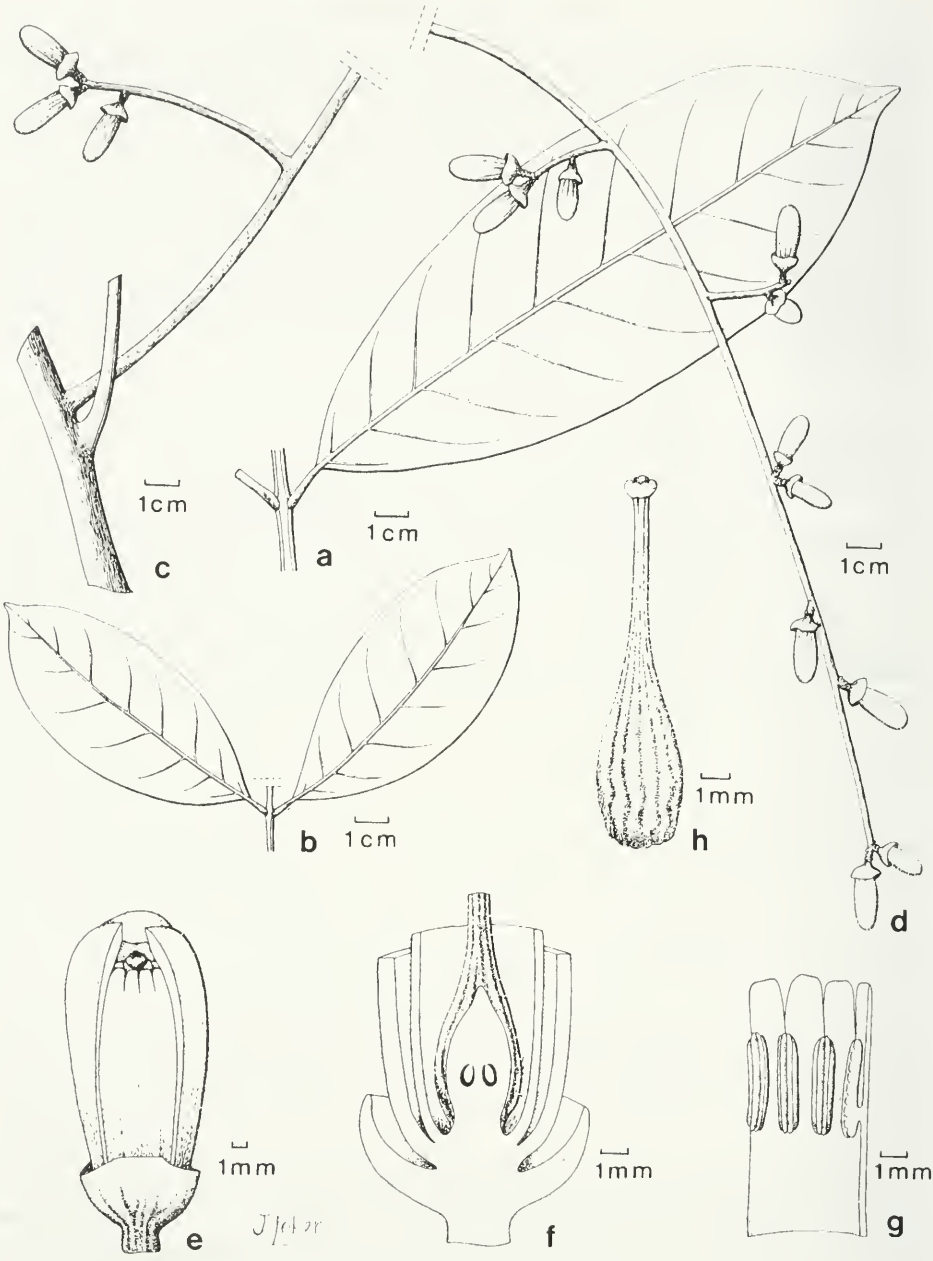

Fig. 26. *Chisocheton vindictae* Mabb. a, b. Leaflets; c, d. inflorescences; e. flower; f. half flower; g. part of staminal tube; h. pistil (*Pringgo Atmodjo 428*). Drawing J. Loken. © The Natural History Museum, London. Bull. Brit. Mus. (Nat. Hist.), Series Botany, vol. 6 (4), 1979.

Fig. 27. *Chisocheton macrophyllus* King. a. Leaf and inflorescence; b. young leaves; c. leaflet; d. half flower; e. fruit. Drawing R. Wise. Reproduced with permission from Tree Flora of Malaya 4.

208; Koord., Exk. Fl. Java 2 (1912) 443; Atlas 1 (1913) t. 166; Ridley, Fl. Malay Penins. 1 (1922) 389; Backer & Bakh. f., Fl. Java 2 (1965) 124; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 345, f. 1; in Tree Fl. Malaya 4 (1989) 235, f. 5.

Chisocheton sp.: Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 22.

[*Chisocheton kingii* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 295, nom. superfl.]

Tree to 35 m, taprooted at least when young; bole to 70 cm diam., with buttresses to 3 m tall and 2 m out, unbranched until a 10 m sapling. Bark smooth to weakly cracking when exposing pale inner bark, greenish brown, inner bark midbrown; sapwood pale fawn, lenticels to 1 cm long. Crown irregular, sparsely branched. *Twigs* stout, conspicuously cicatrose, white latex in pith and phloem. Leafy twigs 1.5–3.5 cm diam. *Leaves* to 240 cm, pseudogemmulate, crowded in terminal spirals; petioles 10–15 cm, ± angled or grooved, like rachis, subglabrous. *Leaflets* in up to 28 pairs, to 39 by 11 cm, oblong, glossy dark green adaxially, minutely pubescent on midrib and also abaxially on veins (densely so in subsp. *fulvescens*), pinkish when young, bases asymmetrical, rounded or, particularly in juveniles, cuneate, apices shortly acuminate, costae 18–25 on each side, spreading, rather prominent adaxially in sicco, petiolules to 13 mm. *Thyrse* to 80 cm, paniculiform, puberulous; branches rather distant, to 12 cm long; ultimate branchlets cymulose, many-flowered, smelling of prunes (Jacobs); pedicels pubescent. *Calyx* c. 3–4 mm tall, cupular, pubescent, margin obscurely 4-lobed to truncate. *Petals* 4 or 5, to 15 mm long, linear-spathulate, puberulous to pubescent without, glabrous within, cream, imbricate, apices concave (corolla clavate in males). *Staminal tube* swollen at mouth, weakly adherent to petals at base, hairy along interlobe sutures near apex without, villous within, margin with 6–8 linear, 2- or 3-toothed lobes to 2.5 mm long; anthers 5–8 (9), c. 2.5 mm long, oblong, locellate, basifixed, sometimes slightly exserted. *Disk* obscure. *Ovary* 4-locular, sericeous; style sericeous in proximal 7/8; stylehead cylindrical with apical lobing. *Capsule* to 15 cm diam., 4-valved, orange-brown, white within. *Seeds* 4, 4.5 cm long, orange-segment-shaped, covered with powdery (?) sarcotesta. — **Fig. 27.**

Distribution — Great Nicobar; *Malesia:* Sumatra, Malay Peninsula, Anambas Islands, Borneo, Java.

Habitat — Rain forest, to 1100 m altitude.

KEY TO THE SUBSPECIES

1a. Leaflets, corolla and capsule densely fulvous pubescent . . **a.** subsp. **fulvescens**
b. Leaflets, corolla and capsule puberulous . . . . . **b.** subsp. **macrophyllus**

a. subsp. **fulvescens**

Chisocheton macrophyllus King subsp. *fulvescens* Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 346.

Distribution — Northern Malay Peninsula and peninsular Thailand.

b. subsp. **macrophyllus**

Chisocheton macrophyllus King subsp. *macrophyllus*: Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 345. — *Chisocheton macrophyllus* King, s.str. — *Chisocheton sp.*: Curtis — *Chisocheton kingii* Harms.

Distribution — Sumatra, Malay Peninsula except north-east, Anambas Islands, Borneo, Java.

Note — Intermediate specimens recorded from Selangor, Pahang and Trengganu.

38. **Chisocheton ceramicus** (Miq.) C.DC.

Chisocheton ceramicus (Miq.) C.DC. in DC., Monogr. Phan. 1 (1878) 533; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 9; in Handb. Fl. Papua New Guinea 1 (1978) 139, t. 68; Johns, Comm. For. Trees Papua New Guinea 5 (1976) 210, 217; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 361; in Tree Fl. Malaya 4 (1989) 234; Hô, Ill. Fl. Vietnam 2, 1 (1992) 493. — *Schizochiton ceramicum* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27, 29.

Schizochiton spectabile Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27, 29. — *Chisocheton spectabilis* (Miq.) C.DC. in DC., Monogr. Phan. 1 (1878) 539; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 320; Adelb., Blumea (1948) 319; Meijer, Bot. News Bull. Sabah 8 (1967) 78.

Schizochiton junghuhnii Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27, 30. — *Chisocheton junghuhnii* (Miq.) C.DC. in DC., Monogr. Phan. 1 (1878) 533.

Chisocheton macrothyrsus King, J. As. Soc. Beng. 64, ii (1895) 33; Koord., Atlas 1 (1913) t. 166; Ridley, Fl. Malay Penins. 1 (1922) 389; Burkill & Hend., Gard. Bull. Str. Settl. 3 (1925) 356.

Chisocheton sandoricocarpus Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 111; Backer, Schoolfl. Java (1911) 209; Koord., Exk. Fl. Java 2 (1912) 443; Backer & Bakh. f., Fl. Java 2 (1965) 124; Corner, Seeds Dicots 1 (1976) 188, 2 (1976) t. 383, right.

?*Chisocheton globosus* Pierre, Fl. Cochinch. 5 (1897) t. 347A; Pellegr. in Fl. Indo-Chine 1 (1911) 740; Briq., Mém. Inst. Nat. Genev. 24 (1935) 66.

Chisocheton clementis Merr., Philipp. J. Sc., Bot. 3 (1908) 145; Enum. Philipp. Flow. Pl. 2 (1923) 367; Briq., Mém. Inst. Nat. Genev. 24 (1935) 67; Elmer, Leafl. Philipp. Bot. 9 (1937) 3345; Heine, Feddes Rep. 54 (1951) 230.

Amoora cupulifera Merr., Philipp. J. Sc., Bot. 9 (1914) 365; Enum. Philipp. Flow. Pl. 2 (1923) 370; Briq., Mém. Inst. Nat. Genev. 24 (1935) 76.

[*Chisocheton vulcanicus* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 367, nom. in syn.]

Amoora mindorensis Merr., Philipp. J. Sc. 27 (1925) 459.

Chisocheton aff. *biroi*: Lane-Poole, Rep. For. Res. Terr. Papua New Guinea (1925) 100.

Chisocheton peekelianus Harms, Notizbl. Bot. Gart. Berlin 10 (1928) 276.

[*Amoora caesifolia* Elmer, Leafl. Philipp. Bot. 9 (1937) 3321, nom. non rite publ.]

Dysoxylum grandifolium auct. non Merr.: Elmer, Leafl. Philipp. Bot. (1937) 3368.

Chisocheton rhytidocalyx Airy Shaw, Bull. Misc. Info. Kew (1940) 256.

Chisocheton doctersii Harms, Bot. Jahrb. 72 (1942) 181.

Chisocheton pachycalyx Harms, Bot. Jahrb. 72 (1942) 186.

Tree to 30 m; bole to 40 cm diam., buttresses to 3 m tall, 2 m out. Bark dippled, lenticellate, dark brown, tardily white-laticiferous; inner bark dark red-brown; sapwood yellow. *Twigs* with conspicuous cicatrices. Leafy twigs 4–12 mm diam. *Leaves* to 1.5 m, pseudogemmulate, up to 17-jugate; petiole 10–15 cm; rachis 2.5–6(–11) mm diam., terete to angled. *Leaflets* (4–)10–38 by (2.7–)5.5–14.5 cm, ovate to oblong, dull mid-green adaxially, paler abaxially, reddish when expanding, inconspicuously adpressed hairy notably on abaxial surface of veins, bases acute to rounded, apices acuminate,

midrib sunken adaxially, costae 10–15 on each side; petiolules (3–)6–13 mm. *Thyrse* to 65 cm long, branched to 2 or 3 orders, fragrant; branches to 45 cm, ± adscendant; pedicels short; pseudopedicels 2.5–3.5 mm long. *Calyx* 2–5.5 mm long, shallowly cupular to cylindrical, sometimes thickened annularly, margin truncate to obscurely 5-lobed. *Petals* (4) 5 (6), 13–19 by 2–3 mm, pinkish, valvate. *Staminal tube* sericeous except at both ends, occasionally subglabrous without, margin (4–)5(–8)-lobed, lobes to 4 mm long, ± truncate; anthers (4) 5 or 6 (9), 2.8–3.8 mm long, locellate. *Ovary* 2- or 3-locular; style densely pubescent except at apex; stylehead shortly cylindrical. *Infructescence* to 45 cm, pendent. *Capsule* to 3.2 cm long, 4.5 cm diam., subglobose, velutinous, fleshy, orange-red, stipe to 1.5 cm long; pericarp thick, spongy, with 2 strong and 2 faint sutures, dehiscing along lines of first, latex white to colourless. *Seeds* 1 or 2, shining pale orange; sarcotesta with 1.5 mm hole near micropyle; cotyledons collateral.

Distribution — Vietnam, Thailand; *Malesia:* Sumatra, Malay Peninsula, Borneo, Java, Philippines, Moluccas (Morotai, Buru, Ceram), New Guinea, New Britain.

Habitat — Primary and secondary forest and as a relic in hedgerows, 0–700(–1100) m altitude.

39. Chisocheton curranii Merr.

Chisocheton curranii Merr., Philipp. J. Sc., Bot. 3 (1908) 234; Enum. Philipp. Flow. Pl. 2 (1923) 367; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 363.

Tree c. 5 m tall. Leafy twigs fawn pubescent. *Leaves* c. 20 cm, to at least 3-jugate, petiole, rachis, petiolules, midribs and nerves densely fawn pubescent. *Leaflets* 8–11 by 3–4.5 cm, elliptic, subcoriaceous, bases acute, apices shortly acuminate, costae c. 7 on each side, venation prominent; petiolules 5–7 mm. *Thyrse* to 15 cm (fide Merrill), paniculiform; branches to 2 cm, spreading or ascending, pubescent. *Calyx* 4–5 mm long, cupulate, pubescent without, margin subtruncate to obscurely lobed. *Petals* 5, to 16 by 2 mm, pubescent without, yellowish white. *Staminal tube* appressed hairy on both surfaces, margin 5-lobed, lobes 2.5 mm long, obtuse; anthers 5, 2.5 mm long. *Ovary* 2-locular, hirsute; style hirsute. *Capsule* (fide Merrill) to 6 cm diam., globose, brown. *Seeds* to 3 cm long.

Distribution — *Malesia:* Philippines (Luzon, known only from the scrappy types).

Habitat — Unknown.

40. Chisocheton pentandrus (Blanco) Merr.

Chisocheton pentandrus (Blanco) Merr., Philipp. Govt. Lab. Bur. Bull. 27 (1905) 210; West & Brown, Bull. Philipp. Dept. Agr. Bur. For. 20 (1920) 119; ibid. 22 (1921) 121; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 367; Philipp. J. Sc. 29 (1926) 378; Elmer, Leafl. Philipp. Bot. 9 (1937) 3347; Harms in Fedde, Rep. 42 (1937) 7; in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 33; Meijer, Bot. News Bull. Sabah 8 (1967) 78; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 363, f. 8; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 1336; Mabb. in Tree Fl. Malaya 4 (1989) 237. — *Trichilia pentandra* Blanco, Fl. Filip. (1837) 355; ed. 2 (1845) 249; M. Roem., Synops. Monogr. 1 (1846) 115; C.DC. in DC., Monogr. Phan. 1 (1878) 749.

Dasycoleum philippinum Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 415; C.DC. in DC., Monogr. Phan. 1 (1878) 540, t. 7 f. 8; Vidal, Sin. Fam. Gen. Pl. Filip. Atl. (1883) t. 29C; Rev. Pl. Vasc. Filip. (1886) 84. — *Chisocheton philippinus* (Turcz.) Harms, Nat. Pflanzenfam. 3, 4 (1896) 296; Perkins, Fragm. Fl. Philipp. (1904) 32; Briq., Mém. Inst. Nat. Genev. 24 (1935) 67.

Schizochiton paucijugum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 27, 30. — *Chisocheton paucijugus* (Miq.) B.D. Jackson, Ind. Kew. 1 (1893) 517; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319.

Dasycoleum beccarianum Baill., Adansonia 11 (1874) 263; C.DC. in DC., Monogr. Phan. 1 (1878) 540. — *Chisocheton beccarianus* (Baill.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319; Univ. Calif. Publ. Bot. 15 (1929) 122; Heine, Mitt. Bot. Staatssamml. München 6 (1953) 218; Meijer, Bot. News Bull. Sabah 8 (1967) 78.

Chisocheton spicatus Hiern in Hook. f., Fl. Brit. India 1 (1875) 550; C.DC. in DC., Monogr. Phan. 1 (1878) 535; Curtis, J. Str. Br. Roy. As. Soc. 25 (1894) 22; King, J. As. Soc. Beng. 64, ii (1895) 26; Ridley, Fl. Malay Penins. 1 (1922) 387; Corner, Life Pl. (1964) t. 42; Seeds Dicots 2 (1976) t. 375c.

Chisocheton ceramicus auct. non C.DC.: Fern.-Vill., Nov. App. (1880) 42.

Chisocheton sp.: Vidal, Rev. Pl. Vasc. Filip. (1886) 82.

Chisocheton microcarpus Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 115; Backer, Schoolfl. Java (1911) 209; Koord., Exk. Fl. Java 2 (1912) 443; Backer & Bakh. f., Fl. Java 2 (1965) 125; Valeton in Hochr., Pl. Bogor. Exsicc. (1904) 69, incl. var. *moluccanus* Valeton; in Hochr., Cat. Bogor. Nov. (1905) 24, incl. var. *moluccanus*; Briq., Mém. Inst. Nat. Genev. 24 (1935) 65, incl. var. *moluccanus* Valeton ('*macrocarpus*').

Chisochiton sp.: Merr., Philipp. J. Sc., Bot. 11 (1916) 280.

Chisocheton parvifoliolus Merr., Philipp. J. Sc., Bot. 13 (1918) 297; Enum. Philipp. Flow. Pl. 2 (1923) 367.

[*Chisocheton sorsogonensis* Elmer ex Merr., Philipp. J. Sc., Bot. 13 (1918) 297, nom. in syn.].

Chisocheton sp.: Merr., Univ. Calif. Publ. Bot. 15 (1929) 122.

Chisocheton curranii auct. non Merr.: Elmer, Leafl. Philipp. Bot. 9 (1937) 3346.

Tree or treelet 3–18(–40, De Vogel) m; bole to 10 m, buttressed to 60 cm. Bark greenish grey; inner bark pale fawn or pinkish; sapwood pale cream. Leafy *twigs* 2.5–6 mm diam., deciduously tawny pubescent to subglabrous. *Leaves* to 45 cm and to 9-jugate; petiole 2–10 cm, terete, minutely pubescent. *Leaflets* to 16.5(–26.5) by 6(–9) cm, elliptic to ovate-oblong, dark green adaxially, paler abaxially, glabrous or sparsely pubescent on veins, bases ± asymmetric, acute to obtuse, apices acuminate to acutely cuspidate, costae 8–16 on each side; petiolules to 8 mm long. *Inflorescence* spiciform to thyrsoid, to 63 cm, axillary to supra-axillary, sometimes in axils of unexpanded leaves; axis finely velvety puberulous; flowers pedicellate, ± fragrant. *Calyx* c. 4 mm long, ± sparsely puberulous without, margin truncate to obscurely or irregularly lobed. *Petals* (4 or) 5, 8–12(–16) by 2 mm, cream, densely fulvescent-hirsute without, valvate, apex acute. *Staminal tube* white, ± densely pilose, rarely subglabrous within, pubescent without; margin 5-lobed, lobes laciniate; anthers 5 (6), 3 mm long, glabrous. *Ovary* 2-locular, shortly stipitate, hirsute; style glabrous to pubescent. *Infructescence* to 30 cm. *Capsule* to 21 mm diam., globose or beaked, dull red, minutely rusty tomentose; pericarp with white latex. *Seeds* 2, to 15 mm diam., flattened, sarcotestal.

Distribution — Peninsular Thailand; *Malesia:* Sumatra and Malay Peninsula to Philippines and Moluccas.

KEY TO THE SUBSPECIES

1a. Fruit spherical; inflorescence ± branched 2
b. Fruit conspicuously beaked; inflorescence ± unbranched; flowers to 18 mm long; leaflet costae 8–12 on each side ..... **c.** subsp. **paucijugus**
2a. Inflorescence branched to four orders; flowers to 8 mm long; costae c. 16 on each side ..... **a.** subsp. **pentandrus**
b. Inflorescence sparsely branched; flowers 8–16 mm; costae c. 13 on each side ... . **b.** subsp. **medius**

Note — The subspecies *pentandrus* and *paucijugus* are allopatric save in northern Borneo and Palawan, where the intermediate populations here given subspecific rank as subsp. *medius*, also occur.

a. subsp. **pentandrus**

Chisocheton pentandrus (Blanco) Merr. subsp. *pentandrus*; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 364, 237. — *Chisocheton pentandrus* (Blanco) Merr., s.str. — *Trichilia pentandra* Blanco — *Dasycoleum philippinum* Turcz. — *Chisocheton ceramicus* auct. non C.DC. — *Chisocheton sp.*: Vidal — *Chisocheton microcarpus* Koord. & Valeton — *Chisocheton philippinus* (Turcz.) Harms — *Chisocheton sp.*: Merr. — *Chisocheton parvifoliolus* Merr. — *Chisocheton sorsogonensis* Elmer ex Merr. — *Chisocheton curranii* auct. non Merr.

Tree to 16(–40) m. Leafy *twigs* 4–6 mm diam. *Leaflets* elliptic-oblong, bases asymmetric, obtuse or acute, costae c. 16 on each side. *Thyrse* branched to 3 or 4 orders; branches to 12 cm long. *Petals* to 8 mm. *Capsule* to 21 mm diam., spherical, abruptly stipitate and minutely beaked; stipe to 8 mm long, 3 mm diam.

Distribution — West *Malesia:* Malay Peninsula (Johore), NE Borneo, Java, Philippines, Celebes, Lesser Sunda Islands (Bali, Sumbawa, Flores), Moluccas (Halmahera, Ambon).

Habitat — Drier lowland forest.

b. subsp. **medius** Mabb.

Chisocheton pentandrus (Blanco) Merr. subsp. *medius* Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 365. — *Chisocheton beccarianus* auct. non Harms: Merr., Heine, Meijer.

Small tree to c. 8 m. Leafy *twigs* c. 4 mm diam. *Leaves* to 32.5 cm, c. 4-jugate; leaflet bases cuneate, apices long acuminate, acumen c. 15 mm, costae c. 13 on each side; petiolule to 5 mm. *Inflorescences* to 30 cm, weakly branched; proximal branches to 6 cm. *Capsule* globose.

Distribution — Northern Borneo and Philippines (Palawan).

Note — In the absence of fruits, it is difficult to assign some specimens. Such gatherings could represent either of the other two subspecies.

c. subsp. **paucijugus** (Miq.) Mabb.

Chisocheton pentandrus (Blanco) Merr. subsp. paucijugus (Miq.) Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 366, 238. — *Schizochiton paucijugum* Miq. — *Dasycoleum beccarianum* Baill. — *Chisocheton spicatus* Hiern — *Chisocheton paucijugus* (Miq.) B.D. Jackson — *Chisocheton sp.*: Merr.

Small tree to 8 m. Leafy *twigs* 2.5–3 mm diam. *Leaves* to 45 cm, 3–5(–6)-jugate. *Leaflets* ovate-oblong, bases cuneate, apices acutely cuspidate, costae c. 8–12 on each side; petiolules 6–8 mm. *Inflorescence* to 24 cm, usually unbranched, bearing cymules of 1–few flowers. *Petals* to 18 mm. *Infructescence* with fruits borne at tip. *Capsule* tapering at each end, the distal acute, proximal terete.

Distribution — Peninsular Thailand; west *Malesia* from Sumatra and Malay Peninsula to Borneo and Philippines (Palawan).

Habitat — Wetter forests.

41. Chisocheton erythrocarpus Hiern

Chisocheton erythrocarpus Hiern in Hook.f., Fl. Brit. India 1 (1875) 368; C.DC. in DC., Monogr. Phan. 1 (1878) 534; King, J. As. Soc. Beng. 64, ii (1895) 31; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 59; Fl. Malay Penins. 1 (1922) 388; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 368; Mal. For. 45 (1982) 235; in Tree Fl. Malaya 4 (1989) 235.
?*Chisocheton sp. C*: Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 372.

Tree to 25 m; bole to 25 cm diam., buttresses to 1 m tall and out, 10 cm thick. Bark smooth to cracking, dark grey to chocolate brown; inner bark reddish brown; wood cream. Crown small. *Twigs* rough, dark brown. Leafy twigs 4–5 mm diam., densely and minutely rusty tomentose. *Leaves* to 36 cm, pseudogemmulate, to 6-jugate; petiole 5–8 cm. *Leaflets* to 10 by 8 cm, elliptic-oblong to broadly ovate, chartaceous, glabrous adaxially save the puberulous midrib, softly and shortly rusty-pubescent abaxially, bases somewhat asymmetric, cuneate or rounded, apices shortly, abruptly and bluntly acuminate, costae 6–8 on each side, somewhat arcuate; petiolule to 1 cm. *Thyrse* to 14 cm, supra-axillary in upper axils, minutely rusty tomentose; lateral branches short, squarrose, cymose; pedicels short. *Calyx* c. 4 mm long, cylindrical, densely tomentose without, glabrous within, margin truncate to praemorse. *Petals* 5 or 6, 9–13 by 3–3.5 mm, narrowly boat-shaped, creamy white, valvate, separating in sicco, fleshy, adpressed sericeous without, glabrous within. *Staminal tube* sericeous without except at base and on lobes, pubescent similarly within, margin with 5 or 6 teeth c. 2.5 mm long, weakly lobed; anthers c. 3 mm long, locellate, subsessile, basifixed at notches between lobes. *Pistil* minutely pubescent save a narrow band below stylehead; stylehead cylindric, spically mamillate, glabrous. *Capsule* to 6 cm diam., globose, peach-like, minutely beaked, minutely tomentose, yellow when immature, blood-red when ripe; pericarp with white latex. *Seeds* 2, c. 2.5 cm long, somewhat flattened; sarcotesta thick, orange-red.

Distribution — *Malesia:* Malay Peninsula, N and E Borneo, Philippines (Mindanao, Samar, Palawan).

Habitat — Primary and secondary forests, predominantly near the coast.

Section Rhetinosperma

Chisocheton sect. *Rhetinosperma* (Radlk.) Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 368. — *Rhetinosperma* Radlk. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, Nachtr. 3 (1908) 204 (genus).

Trees. *Indumentum* of stellate hairs on vegetative parts. *Leaves* pseudogemmulate with pseudogemmula approaching tardy apical development of some *Dysoxylum* spp. *Inflorescences* axillary to supra-axillary. *Petals* valvate (or imbricate), separating in sicco. *Anthers* scarcely locellate. *Disk* cupular. *Seeds* sarcotestal.

Distribution — Four species from NE Borneo eastwards to New Hebrides. Two endemic in *Malesia*, one also extending to Solomon Islands and Queensland, the fourth (*Chisocheton rex* Mabb.) restricted to New Hebrides.

42. Chisocheton koordersii Mabb.

Chisocheton koordersii Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 368. — *Chisocheton kingii* Koord., Minah. (1898) 385, 636; Fl. NO Celebes, Suppl. 2 (1922) t. 43, non Harms (1896). — *Chisocheton paohaniana* Li & Chen, Acta Phytotax. Sin. 22 (1984) 495, nom. superfl.

Tree to 30 m; bole to 14 m, 60 cm diam., buttresses to 1.5 m. Bark rather rough, finely fissured, brown, 0.5 mm thick; inner bark 5 mm thick, yellow to whitish; sapwood white. Leafy *twigs* (6–)8–12 mm diam.; pith wide, sometimes housing ants. Young twigs, petioles, rachides, pseudogemmulae and leaflets, especially veins abaxially minutely stellate (4-armed) pubescent. *Leaves* to at least 35 cm and 7-jugate, pseudogemmulate; petiole to 18 cm, terete. *Leaflets* to 25(–35) by 10 cm, elliptic to suboblong, bases rounded, symmetrical, apices acuminate, costae up to 17 on each side; petiolules 5–9 mm. *Thyrses* to 45 cm, axillary, paniculiform, branched to third order; major proximal branches to 18 cm. *Flowers* apparently bisexual and ebracteate, sessile, with short pseudopedicel, scented. *Calyx* 3.5–4 mm long, c. 2.5–3 mm diam., tubular-urceolate, minutely stellate-pubescent without, glabrous within, margin obscurely lobed, almost praemorse. *Petals* 5 or 6, 11–12 mm long, white, narrowly spathulate, densely and minutely stellate-pubescent without, glabrous within, valvate, connate in most proximal 1/4 to 1/3. *Staminal tube* long simple villous without in band below lobes, glabrous within save a band of small ascendant simple hairs just below anthers, margin 5- or 6-lobed, lobes c. 2.5 mm long, ± bifid, glabrous; anthers 5 or 6, c. 2–2.5 mm long, minutely apiculate, alocellate, glabrous, sessile, basifixed in angle of lobes. *Disk* cupular, c. 1.5 mm tall, adnate to ovary, glabrous. *Ovary* c. 2.5 mm long, minutely pubescent; style minutely pubescent in proximal 1/3 to 1/2; stylehead capitate. *Capsule* 5 cm, spherical, shortly stipitate, reddish tomentellous, 2-valved. *Seeds* 2, c. 3.5 cm diam., scutellar, sarcotestal.

Distribution — *Malesia:* eastern Borneo and Celebes.

Habitat — Rain forest, 10–600 m altitude.

43. Chisocheton stellatus P.F. Stevens

Chisocheton stellatus P.F. Stevens, Contr. Herb. Austral. 11 (1975) 43, t. 6; in Handb. Fl. Papua New Guinea 1 (1978) 166, t. 80; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 371.

Tree to 30 m, bole to 60 cm diam. Bark brown, smooth to flaking; inner bark brown to yellowish; sapwood white to straw. Leafy *twigs* c. 6 mm diam., stellate-velutinous. *Leaves* to 30 cm, to 9-jugate, pseudogemmulate; petiole 8–15 cm. *Leaflets* to 17 by 8.5 cm, ovate to oblong, stellate-hairy on both surfaces, sometimes velutinous abaxially, bases rounded, apices ± rounded, midrib impressed adaxially in sicco, costae up to 18 on each side, venation prominulous abaxially; petiolules 4–8 mm. *Thyrses* to 45 cm, once or twice-branched; branches to 22.5 cm with congested cymules of flowers; bracts c. 1 mm long, triangular. *Calyx* 1.3–1.7 mm long, densely pilose without, margin ± truncate. *Petals* 5 (6), 4–5.5 by 0.7–1 mm, oblong-ligulate, whitish to yellow-green, densely pubescent without, valvate. *Staminal tube* pubescent without save at both ends and within a little below anthers, margin 5- (or 6-)lobed, lobes 1–1.2 mm long, retuse; anthers 5 (6), 0.8–1 mm long, scarcely locellate, connective pilose. *Disk* c. 0.4–0.8 mm tall, glabrous, margin crenulate. *Ovary* 2-locular, densely pubescent; style ± glabrous; stylehead 0.4 mm diam. *Female flowers* and *fruits* unknown.

Distribution — *Malesia:* northern New Guinea.

Habitat — Rain forest, to 150 m altitude.

44. **Chisocheton longistipitatus** (F.M. Bailey) L.S. Smith

Chisocheton longistipitatus (F.M. Bailey) L.S. Smith, Proc. Roy. Soc. Queensl. 70 (1959) 29; P.F. Stevens, Contr. Herb. Austral. 11 (1975) 16; in Handb. Fl. Papua New Guinea 1 (1978) 144, t. 70; Johns, Comm. For. Trees Papua New Guinea 5 (1976) 217; Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 371. — *Castanospora longistipitata* F.M. Bailey, Queensl. Fl. 1 (1899) 288. — *Rhetinosperma longistipitata* (F.M. Bailey) Radlk. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, Nachtr. 3 (1908) 204.

Chisocheton polyanthus Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1901) 383; Bot. Jahrb. 72 (1942) 187.

Tree to 39 m; bole to 75 cm diam., buttresses to 1.5 m. Bark dark brown, lenticellate; inner bark pale pink to yellowish; sapwood white. Leafy *twigs* 4–8 mm diam., sometimes myrmecophilous, occasionally with white latex. *Leaves* to 1 m and 18-jugate; petiole 7–10 cm; rachis 2–4.5 mm diam., terete or channelled, pseudogemmula short, clawlike. *Leaflets* 9–32 by 4.2–13 cm, elliptic-oblong, sparsely stellate-pubescent, midrib sunken adaxially in sicco, costae c. 18 on each side; petiolules 4–8 mm. *Inflorescences* to 45 cm, 3 or 4 times branched, proximal branches to 10 cm. *Calyx* 1.5–3 mm tall, ± sessile, margin irregularly lobed to 1 mm. *Petals* 4 or 5, 6–7 by 0.4–0.7(–1) mm. *Staminal tube* pubescent except at ends, margin (4)5-lobed, lobes 1.4–1.8 mm, retuse; anthers (4) 5, 0.8–1.3 mm long, scarcely locellate. *Disk* cupular. *Ovary* 2-(or 3-)locular; style stellate-pubescent save near apex; stylehead cylindric, apically mamillate. *Infructescence* to 30 cm. *Capsule* 3–3.5 cm long, subspherical, reddish, stipitate, stipe 1.2 cm; pericarp spongy. *Seeds* 2 (3), sarcotestal with hole near micropyle; cotyledons collateral. — **Fig. 28.**

Distribution — Australia (northern Queensland), Solomon Islands; *Malesia:* New Guinea.

Habitat — Rain forest, to 1065 m altitude.

Fig. 28. *Chisocheton longistipitatus* (F.M. Bailey) L.S. Smith. Shoot with infructescences. Papua New Guinea, Cape Rodney (*Mabberley 1793*). Photograph D.J. Mabberley, July 1974.

Note — Stevens (op. cit. 18) notes that *Schodde 2404* from the Southern Highlands of Papua New Guinea may represent a new species allied to *Chisocheton longistipitatus*, from which it differs in its larger fruit with a lignified pericarp.

INSUFFICIENTLY KNOWN SPECIES

45. Chisocheton species A

Chisocheton species A, Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 372 (Sect. *Chisocheton* series *Schumanniani*).

Tree to 4 m. Leaves small with small leaflets. Fruits 3-locular, pink.

Note — Known from two gatherings from Western Province, Papua New Guinea and apparently distinct from other members of the series.

46. Chisocheton species B

Chisocheton species B, Mabb., Bull. Brit. Mus. Nat. Hist., Bot. 6 (1979) 372 (Sect. *Holopentas* series *Sandoricocarpi*).

Tree 20 m tall; bole to 35 cm diam. Bark smooth, greyish, hoopmarked; buttresses to 1.3 m, 7.5 cm thick. Leaves to 70 cm. Leaflets to 7 by 8 cm, bluntly long-acuminate, velutinous abaxially, weakly pubescent on veins adaxially, costae c. 15 on each side. Thyrse supra-axillary, c. 70 cm long, branches to 22 cm, all brown long-tomentose (flowers immature). Calyx irregularly lobed. Petals 5. Anthers 5, locellate. Disk absent. Style glabrous. Capsule c. 5 cm diam., red, velutinous. Seeds 2.

Note — Known from a few collections in Sarawak and Kalimantan.

Tribus Aglaieae

Aglaieae Blume, Bijdr. (1825) 169; T.D. Penn., Blumea 22 (1975) 480.

Leaves usually pinnate, rarely trifoliolate or unifoliolate. *Indumentum* usually of simple or stellate hairs or peltate scales. *Flowers* hermaphrodite or unisexual (plant dioecious). *Staminal tube* usually globular or cyathiform, unlobed. *Disk* absent. *Fruit* usually a berry, less often a capsule. *Seeds* arillate or with sarcotesta, without endosperm; cotyledons usually superposed, radicle included.

Distribution — Five genera restricted to the Asiatic tropics and extending into the western Pacific. All, except *Sphaerosacme* Wall. ex Royle, of which there is one species, *S. decandra* (Wall.) T.D. Penn., restricted to the Himalayas, are represented in Malesia.

APHANAMIXIS

Aphanamixis Blume, Bijdr. (1825) 165; DC., Prodr. 7, 2 (1839) 766 ('*Aphanomyxis*'); T.D. Penn., Blumea 22 (1975) 485; Mabb., Blumea 31 (1985) 136. — *Amoora* Roxb. sect. *Aphanamixis* (Blume) C.DC. in DC., Monogr. Phan. 1 (1878) 579.

Andersonia Roxb. [Hort. Beng. (1814) 87, nom. nud., p.p.]; Fl. Ind., ed. Carey (1832) 212, non R. Br. (1810).

Sphaerosacme Wall., Cat. (1829) n. 1277, nom. nud., p.p., non Wall. ex Royle (1835).

Amoora Roxb. sect. *Euamoora* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 34, nom. illeg. [Type, *Aglaia cucullata*, q.v., incl. in sect. '*Notamoora*' Miq., i.e. sect. *Amoora*, = *Aglaia* Lour. sect. *Amoora* (Roxb.) Pannell.]

[*Chuniodendron* Hu, J. Roy. Hort. Soc. 63 (1938) 387, nom. nud.]

?*Ricinocarpodendron* Boehm. in Ludw., Defin. Gen. Pl. (1760) 512; cf. Mabb., Blumea 31 (1985) 136.

Trees or pachycaul treelets with cicatrose twigs. *Indumentum* of simple (in *A. polystachya* sometimes basally bifid and stellate) hairs. *Leaves* imparipinnate, leaflets opposite. *Inflorescences* axillary to supra-axillary, male flowers in panicles, female and hermaphrodite in long spikes or racemes, rarely panicles. Male *flowers* distinctly smaller than others. *Calyx* deeply 5-lobed, lobes imbricate. *Petals* 3, imbricate, united with staminal tube basally. *Staminal tube* globose to deeply cyathiform; anthers 3–8, glabrous, inserted within tube. *Disk* absent. *Ovary* 3- (or 4-)locular, each locule with (1) 2 collateral to superposed ovules; style stout; stylehead conical to truncate, 3-angled or with impressions of anthers. *Fruit* a 2- or 3- (4-)valved, loculicidal capsule, locules 1- or 2-seeded. *Seeds* arillate, cotyledons plano-convex, collateral (?) united; radicle small, superior, included. Germination cryptocotylar; cophylls opposite, simple, toothed. 2n = 36, 76, c. 150.

Distribution — Three closely related species in Indomalesia from Sri Lanka and India to Bhutan, tropical China and Indochina, throughout *Malesia*, to the Solomon Islands.

Note — All three species were originally referred to *Andersonia* Roxb. (or *Amoora*), i.e. *Aglaia* Lour., to which *Aphanamixis* is very closely related. Except for the apparent unity of the cotyledons (a feature not investigated in all *Aglaia* spp. so far), there is no other macroscopic character which separates them absolutely. At the microscopic level, only one *Aglaia* species has the 4-colporate pollen grains found in *Aphanamixis* and the wood of the latter differs from that of the *Aglaia* species formerly included in *Amoora* in having confluent and banded paratracheal parenchyma (T.D. Pennington, l.c.).

KEY TO THE SPECIES

1a. Small treelet, often unbranched and flowering when 1 m tall; leaflets ± equal at base; anthers 3. — Malay Peninsula, Sumatra ..... **3. A. sumatrana**
b. Treelet or tree to 20(–35) m; leaflets ± markedly asymmetric, anthers 6 2
2a. Costae conspicuously looped well clear of margin; petiolules 15–30 mm, the terminal one to 45 mm. — Borneo, S Philippines ..... **2. A. borneensis**
b. Costae not so; petiolules 4–10 mm, the terminal one to 15 mm ..... **1. A. polystachya**

1. Aphanamixis polystachya (Wall.) R.N. Parker

Aphanamixis polystachya (Wall.) R.N. Parker, Ind. For. 57 (1931) 486; Merr., Contr. Arnold Arbor. 8 (1934) 82; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 189; Pellegr. in Fl. Indo-Chine, Suppl. 1 (1948) 714; Anon., Wealth India 1 (1948) 86; How & Chen, Acta Phytotax. Sin. 4 (1955) 28; Sant., Fl. Khand., ed. 3 (1967) 37; Anon., Icon. Corm. Sin. 2 (1972) 570, t. 2870; Chun, Fl. Hainan 3 (1974) 69, t. 570; Wu, Fl. Yunnan. 1 (1977) 230; Mabb., Blumea 31 (1985) 137; in Tree Fl. Malaya 4 (1989) 230; Hô, Ill. Fl. Vietnam 2, 1 (1992) 495. — *Aglaia? polystachya* Wall. in Roxb., Fl. Ind. 2 (1824) 429; Spreng., Syst. Veg. 4, 2 (1827) 250; Pellegr. in Fl. Indo-Chine 1 (1911) 768. — [*Sphaerosacme polystachia* Wall., Cat. (1829) n. 1277, nom. nud.] — *Amoora polystachya* (Wall.) Wight & Arn. ex Steud., Nomencl., ed. 2, 1 (1840) 78; M. Roem., Synops. Monogr. 1 (1846) 100; Craib, Fl. Siam. Enum. 1 (1926) 260. — *Ricinocarpodendron polystachyum* (Wall.) Mabb., Mal. For. 45 (1982) 454.

Andersonia rohituka Roxb., Hort. Beng. (1814) 87 ('*rohitoka*'), nom. nud.; Fl. Ind., ed. Carey, 2 (1832) 213; Griff., Notul. 4 (1854) 507 ('*rohitoca*'); Ic. 4 (1854) t. 589, f. 3. — *Amoora rohituka* (Roxb.) Wight & Arn. in Wight, Cat. (1833) 24; Prodr. (1834) 119; Drury, Handb. Ind. Fl. 1 (1864) 164; Bedd., Fl. Sylv. (1871) t. 132; Brandis, For. Fl. (1874) 69, 573; Hiern in Hook. f., Fl. Brit. India 1 (1875) 559; Kurz, For. Fl. Burma 1 (1877) 220; C.DC. in DC., Monogr. Phan. 1 (1878) 181, t. 7, f. 7; Fern.-Vill., Nov. App. (1880) 43; Trimen, Fl. Ceyl. 1 (1893) 249; King, J. As. Soc. Beng. 64, ii (1895) 53; Koord., Minah. (1898) 384; Gamble, Man. Ind. Timb., ed. 2 (1902) 150; Cooke, Fl. Bomb. 1 (1902) 211; Prain, Beng. Pl. 1 (1903) 220; Brandis, Indian Trees (1906) 141; Talbot, For. Fl. Bomb. 1 (1909) 238, t. 141; Gamble, Fl. Madras 1 (1915) 181; Trav. Lab. Mat. Med. Paris 10, 4 (1917) 57, 92; Basu, Ind. Med. Pl. (1918) 312, t. 223; Troup, Silv. Ind. Trees 1 (1921) 285; C.E. Parkinson, For. Fl. Andam. (1923) 123; Baker f., J. Bot. 61, Suppl. (1923) 8; Kanj. et al., Fl. Assam 1, 2 (1936) 236; Worth., Ceylon Trees (1959) 122; Vaughan, Struct. Util. Oilseeds (1970) 161, t. 84 A–D. — *Aphanamixis rohituka* (Roxb.) Pierre, Fl. For. Cochinch. 5 (1895) sub t. 334, nom. nud.; (1897) t. 344B; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 162 f. Q; Ridley, Fl. Malay Penins. 1 (1922) 401; Burtt Davy, Trop. Woods 15 (1928) 26.

Aphanamixis grandifolia Blume, Bijdr. (1825) 165; Spreng., Syst. Veg. 4, 2 (1827) 251; G. Don, Gen. Syst. 1 (1831) 685; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 224; M. Roem., Synops. Monogr. 1 (1846) 100; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 119; Koord., Exk. Fl. Java 2 (1912) 444; Merr., Lingn. Sc. J. 9 (1930) 38; How & Chen, Acta Phytotax. Sin. 4 (1955) 28; Backer & Bakh. f., Fl. Java 3 (1968) 654; Anon., Fl. Hainan 3 (1974) 68; T.D. Penn., Blumea 22 (1975) 487, t. 10 f. a, b; Corner, Seeds Dicots 1 (1976) 186; 2 (1976) t. 378–380; Wu, Fl. Yunnan. 1 (1977) 228, t. 54. — *Amoora grandifolia* (Blume) Walp., Rep. 1 (1842) 429; C.DC. in DC., Monogr. Phan. 1 (1878) 581, incl. var. *pubescens* (Miq.) C.DC.; Fern.-Vill., Nov. App. (1880) 43; Hochr., Cat. Bogor. Nov. (1905) 11; Koord., Exk. Fl. Java 2 (1912) 443; Rock, Orn. Trees Hawaii (1917) 125, t. 51; Backer & Bakh. f., Fl. Java 2 (1965) 125. — *Amoora aphanamixis* Schultes & Schultes, Syst. Veg. 7 (1830) 1621 ('*Amura*'), nom. superfl.; Miq., Fl. Ind. Bat. 1, 2 (1859) 535; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 34, incl. var. *pubescens* Miq. quoad infl., infr.; King, J. As. Soc. Beng. 64, ii (1895) 54; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 19; Backer, Schoolfl. Java (1911) 216; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 897. — *Aglaia aphanamixis* Pellegr. in Fl. Indo-Chine 1 (1911) 767, nom. superfl., incl. var. *frutescens* (C.DC.) Pellegr.

Aphanamixis perrotetiana A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 239; Linnaea 6 lit. (1831) 112 ('*perrottetiana*'); Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 259, t. 14, f. 9a; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 369; Elmer, Leafl. Philipp. Bot. 9 (1937) 3335. — *Amoora perrotetiana* (A. Juss.) Steud., Nomencl., ed. 2, 1 (1840) 78; Walp., Rep. 1 (1842) 429; M. Roem., Synops. Monogr. 1 (1846) 100; C.DC. in DC., Monogr. Phan. 1 (1878) 580; Fern.-Vill., Nov. App. (1880) 43.

Aphanamixis timorensis A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 239; Linnaea 6 lit. (1831) 111; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 259, t. 14, f. 9b; Decne., Herb. Timor. (1835) 116; M. Roem., Synops. Monogr. 1 (1846) 100; Miq., Fl. Ind. Bat. 1, 2 (1859) 536. — *Amoora timorensis* (A. Juss.) Wight & Arn. ex Steud., Nomencl., ed. 2, 1 (1840) 78; M. Roem., Synops. Monogr. 1 (1846) 100; Miq., Fl. Ind. Bat. 1, 2 (1859) 34; C.DC. in DC., Monogr. Phan. 1 (1878) 579; Fern.-Vill., Nov. App. (1880) 43; Vidal, Fl. For. Filip. Atl. (1883) t. 29, f. D; Rev. Pl. Vasc. Filip. (1886) 83.

[*Meliacea wightiana* Wall., Cat. (1831/2) n. 4888, nom. nud.]

[*Sphaerosacme spicata* Wall., Cat. (1831/2) n. 4895, nom. nud. — *Buchanania spicata* Roxb. ex Wall., l.c., nom. in syn.]

Guarea amaris Buch.-Ham., Mem. Wern. Soc. 6 (1832) 307; Steud., Nom., ed. 2, 1 (1840) 709 ('*amyris*').

Trichilia tripetala Blanco, Fl. Filip. (1837) 354; ed. 2 (1845) 248; ed. 3, 2 (1878) 354. — *Aphanamixis tripetala* (Blanco) Merr., Sp. Blanc. (1918) 211; Enum. Philipp. Flow. Pl. 2 (1923) 370; Elmer, Leafl. Philipp. Bot. (1937) 3338; Chang, For. J. Taiw. Prov. Ping. Inst. Agr. 19 (1977) 14, t. 3; Quart. J. Chin. For. 11 (1978) 76.

Amoora macrophylla Nimmo in J. Graham, Cat. Pl. Bombay (1839) 31.

Amoora cucullata auct. non Roxb.: Steud., Nomencl., ed. 2, 1 (1840) 78, 233, quoad syn. *Buchanania paniculata* Roxb.; Llanos ex Fern.-Vill. in Blanco, Fl. Filip., ed. 3, 4, 1 (1880) 106, quoad syn.

[*Aphanamixis blumei* Span., Linnaea 15 (1841) 182, nom. in syn.]

[*Dysoxylum spiciflorum* Zipp. ex Span., op. cit. (1841) 183, nom. nud.]

Amoora amboinensis Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 36; C.DC. in DC., Monogr. Phan. 1 (1878) 582; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 896. — *Aphanamixis amboinensis* (Miq.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296, nom. nud.

[*Piper hyalinum* Reinw. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 34, nom. in syn.]

Dysoxylum cuneatum Hiern in Hook. f., Fl. Brit. India 1 (1875) 549, quoad infr.; King, J. As. Soc. Beng. 64, ii (1895) 47. — *Alliaria cuneata* (Hiern) Kuntze, Rev. Gen. Pl. 1 (1891) 109. — *Epicharis cuneata* (Hiern) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 168, quoad fr.

Cabralea richardiana C.DC. in Mart., Fl. Bras. 11, 1 (1878) 176.

Amoora cumingiana C.DC. in DC., Monogr. Phan. 1 (1878) 580; Fern.-Vill., Nov. App. (1880) 43; Vidal, Phan. Cuming. (1885) 102; Rev. Pl. Vasc. Filip. (1886) 83; Merr., Philipp. J. Sc. 1, Suppl. (1906) 72; Yenko et al., Philipp. J. Sc. 55 (1934) t. 1, f. 2. — *Aphanamixis cumingiana* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296, nom. nud.; ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 369; Elmer, Leafl. Philipp. Bot. 9 (1937) 3331. — *Ricinocarpodendron cumingianum* (C.DC.) Mabb., Mal. For. 45 (1982) 454.

Amoora myrmecophila Warb., Bot. Jahrb. 18 (1894) 194; C.DC., Bull. Herb. Boiss. II, 3 (1903) 170. — *Aphanamixis myrmecophila* (Warb.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296, nom. nud.; in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 383; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 314.

Amoora megalophylla C.DC., Bull. Herb. Boiss. 2 (1894) 577, incl. var. *frutescens* C.DC.

Aphanamixis cochinchinensis Pierre, Fl. For. Cochinch. 5 (1897) t. 343B. — *Aglaia cochinchinensis* (Pierre) Pellegr. in Fl. Indo-Chine 1 (1911) 769, non Pierre.

Aphanamixis lauterbachii Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 383; Bot. Jahrb. 72 (1942) 160. — *Amoora lauterbachii* (Harms) C.DC., Bull. Herb. Boiss. II, 3 (1903) 170.

Aphanamixis macrocalyx Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 384. — *Amoora macrocalyx* (Harms) C.DC., Bull. Herb. Boiss. II, 3 (1903) 170.

Amoora elmeri Merr., Philipp. Govt. Lab. Bur. Bull. 29 (1905) 23. — *Aphanamixis elmeri* (Merr.) Merr., Philipp. J. Sc., Bot. 11 (1916) 15 ('*Aphanamyxis*').

Amoora polillensis Robins., Philipp. J. Sc., Bot. 6 (1911) 206. — *Aphanamixis polillensis* (Robins.) Merr., Enum. Philipp. Flow. Pl. 2 (1923) 370.

Aphanamixis coriacea Merr., Philipp. J. Sc., Bot. 11 (1916) 14 ('*Aphanamyxis*'); Enum. Philipp. Flow. Pl. 2 (1923) 369; Elmer, Leafl. Philipp. Bot. 9 (1937) 3330.

Dysoxylum cauliflorum auct. non Hiern: Ridley, Fl. Malay Penins. 1 (1922) 396, quoad infr., quoad var. *elongatum* Ridley.

Amoora sogerensis Baker f., J. Bot. 61, Suppl. (1923) 8.

Aphanamixis pinatubensis Elmer, Leafl. Philipp. Bot. 9 (1934) 3205, (1937) 3336.

[*Aphanamixis agusanensis* Elmer, Leafl. Philipp. Bot. (1937) 3328, nom. non rite publ.]

[*Aphanamixis apoensis* Elmer, op. cit. (1937) 3326, nom. non rite publ.]

[*Aphanamixis davaoensis* Elmer, op. cit. (1937) 3331, nom. non rite publ.]

[*Aphanamixis obliquifolia* Elmer, op. cit. (1937) 3333, nom. non rite publ.]

[*Aphanamixis velutina* Elmer, op. cit. (1937) 3338, nom. non rite publ.]

[*Chuniodendron spicatum* Hu, J. Roy. Hort. Soc. 63 (1938) 387, t. 104, nom. non rite publ.]

[*Chuniodendron yunnanense* Hu, l.c., t. 105, nom. non rite publ.]

Aphanamixis schlechteri Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 127, 176, nom. nud.; Bot. Jahrb. 72 (1942) 160.

Aglaia janowskyi Harms, Bot. Jahrb. 72 (1942) 176. — *Amoora janowskyi* (Harms) Kosterm., Reinwardtia 7 (1966) 265.

Aphanamixis sinensis How & Chen, Acta Phytotax. Sin. 4 (1955) 29, t. 3; Anon., Fl. Hainan 3 (1974) 69; Wu, Fl. Yunnan. 1 (1977) 230.

Amoora beddomei Kosterm., Acta Bot. Neerl. 31 (1982) 133; Kamble & Sharma, J. Econ. Tax. Bot. 5 (1984) 493. — *Aglaia beddomei* (Kosterm.) Jain & Gaur, J. Econ. Tax. Bot. 7 (1989) 465.

[*Lansium montanum* Rumph., Herb. Amb. 1 (1741) 154, t. 56.]

Pachycaul treelet or tree to 20(–35) m, often flowering when very small; bole to 70 cm diam., often crooked, sometimes with buttresses to 1(–2) m. Bark reddish-brown, flaking; inner bark pinkish, often with white latex; sapwood white; heartwood pink. Leafy *shoots* 7–22 mm diam., lenticellate, sometimes myrmecophilous, subglabrous to finely fulvous tomentellous. *Leaves* 45–125 cm, (4–)6–10-jugate, red when young, glabrous or less often petiole, rachis and abaxial surface of leaflets and adaxial surface of veins ± brown pubescent (in sicco), the hairs simple, basally bifid or stellate or a mixture of these; petiole 5–15 cm, 6–9 mm diam., ± lenticellate, terete but greatly swollen and flattened or channelled adaxially near base. *Leaflets* 7.5–25 by 4–9 cm, oblong to elliptic-oblong, subcoriaceous, bases rounded to acute or attenuate, usually markedly asymmetric, apices cuspidate; petiolules 4–10 mm, the apical one to 15 mm, swollen, costae 10–12 on each side, spreading, tertiary venation sometimes prominulous in sicco. *Inflorescences* to 110 cm in female, 50 cm in male and hermaphrodite, but

often very much shorter, ± supra-axillary; branches to 15 cm, subsquarrose; axes ± puberulous or pubescent; bracteoles c. 0.5 mm, scale-like; pedicels 0–4(–8) mm. *Flowers* c. 4–9 mm diam., sweetly scented (foetid, Elmer). *Calyx* lobes c. 2–3 mm diam., subrotund, ± pubescent without, reddish margin ciliate. *Petals* c. 3–5(–7) mm diam., subrotund, ± pubescent without, glabrous within, cream to yellow or bronze, sometimes tinged red, waxy. *Staminal tube* cream; anthers (5) 6 (8), c. 2.5–4 mm long, elliptic, apiculate, glabrous. *Infructescence* spicate, rarely paniculate. *Capsule* c. 2–4 cm diam., yellowish at first, pink or red at maturity, glabrous; pericarp sometimes with white latex, white within. *Seeds* 1–3, c. 17–22 mm long, plano-convex, hanging by strips of endocarp from capsule, ± covered with brownish red or orange oily aril; testa dark brown or black. 2n = 36, 76, c.150.

Distribution — As for genus. Long cultivated in the New World and under glass in Europe.

Habitat & Ecology — Lowland and hill rain forest to 1400 m altitude (1800 m in India), including seasonally flooded forest, secondary forest and forest on limestone. In hill forest in New Guinea it may be very common and there and elsewhere is often collected from riverbanks where it is conspicuous. The flowers are visited by sweatbees (Stevens in *LAE 54759*).

Vernacular names — Flores: patjer pake; Moluccas: komalo (Tobaro); New Guinea: esaro (Samotong), herrib (Manikiong), kamun (Mooi), kungwan (Maprik), nimigwalap (Kasimin), peah (Matapaili); New Britain: la kameso (Nakanai).

Uses — The timber is used in house construction in New Guinea and Thailand and is suitable for furniture. In India, a commercially valuable oil for soapmaking is extracted from the seeds (43.5% by weight) and this, like the bark, has some medicinal value, the latter in a liniment used in the treatment of rheumatism. In the Moluccas (Central Halmahera), the mashed leaves in a water solution are sprayed on fruiting heads of rice against disease (*De Vogel 4363*) and recent research in China and Bangladesh has shown extracts from twigs, bark, fruits and seeds to be efficacious antifeedants, deterring a range of insect pests.

Notes — 1. This is a polymorphic species within which local variants may appear very distinctive, though linked by intermediates elsewhere. Myrmecophilous forms are common in New Guinea, rare elsewhere, while there are very pubescent forms in the Philippines, less frequently collected in New Guinea and Java. The length of the pedicels, colour of the flowers and height of the trees also vary but there seems to be little correlation between the variation of these different characters and little of it is linked with geography. Nevertheless, in a local context it may be useful, as in *Vavaea amicorum* Benth. (q.v.) and *Chisocheton patens* Blume (q.v.) to recognize such variants in an informal way. This is more fully discussed by Mabberley (l.c.).

2. Forms with up to 3 spikes per axil have been found in the Philippines. In Thailand a form with a bud at the apex of the inflorescence rather like that in cultivated forms of *Melia azedarach* L. (q.v.) has been found.

3. Using cultivated material in India, R.B. Ghosh [An. Aula Dei 11 (1972) 396] showed seeds formed without fertilization, adventitious embryos arising from the nucellus.

Fig. 29. *Aphanamixis borneensis* (Miq.) Merr. a. Leaf; b. male inflorescence; c. female inflorescence; d. half male flower; e. half female flower; f. infructescence; g. fruit; h. seeds (a: *Bianchi 35*; b: *SAN 61233*; c: *SAN 26412*; d: *Mabberley 1706*; e: *Clemens 30483*; f–h: *Chazali S 13657*). Drawing R. van Crevel.

4. Seed structure has been investigated by Corner [Seeds Dicots 1 (1976) 186] who has shown that the narrow white strip on the adaxial surface is the extended chalaza with the aril-attachment on either side and that the free testa and tegmen are restricted to the upper micropylar quarter of the seed, the rest being invested in a vascularized pachychalaza. As there is no evident funicle and part of the aril is exostomal, the aril is exactly intermediate between the funicular aril and the exostomal arilloid: 'it disposes of the academic distinction'. The free integuments resemble in structure those of *Celastraceae*, the pachychalazal part being reminiscent of *Sapindaceae*.

2. Aphanamixis borneensis (Miq.) Merr.

Aphanamixis borneensis (Miq.) Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 321; Mabb., Blumea 31 (1985) 138. — *Amoora borneensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 36; C.DC. in DC., Monogr. Phan. 1 (1878) 583. — *Aphanamixis borneensis* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296, nom. nud. — *Ricinocarpodendron borneense* (Miq.) Mabb., Mal. For. 45 (1982) 454.

Aphanamixis sumatrana auct. non Ridley: Merr., J. Str. Br. Roy. As. Soc. 96 (1922) 317; Univ. Calif. Publ. Bot. (1929) 123.

Aphanamixis pedicellata Ridley, Bull. Misc. Info. Kew (1930) 370; Heine, Feddes Rep. 54 (1951) 230.

[*Aphanamixis pulgarensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 336, nom. non rite publ.]

Walsura punctata Süss. var. *papillosa* Süss. & Heine, Mitt. Bot. Staatssamml. München 2 (1950) 59; Heine, Feddes Rep. 54 (1951) 231.

Tree to 10(–13.5) m; bole to 15 cm diam. Bark reddish; inner bark orangeish-mottled, soft, with watery latex; sapwood orange. Leafy *twigs* 5–10 mm diam., greyish. *Leaves* 30–80 cm, (3–)6–8-jugate; petiole 15–18 cm, c. 5 mm diam., terete, puberulous, flattened to grooved or hollowed adaxially at base, the groove adpressed fulvous pubescent. *Leaflets* 7–25 by 4–7.5 cm, lanceolate to narrowly elliptic-oblong or oblanceolate, coriaceous and particularly at altitude, glabrous, bases acute to attenuate, weakly asymmetric, apices acute to cuspidate or acuminate, the acumen to 15 mm long, costae 9–12 on each side, conspicuously looped well clear of margin, often prominent abaxially, tertiary venation reticulate; petiolules 15–30 mm, the terminal one to 45 mm, swollen at base. *Inflorescences* to 65 cm, the male with subsquarrose branches to 15 cm, strongly supra-axillary; axes puberulous; bracteoles c. 0.5 mm, scale-like; pedicels 0–1 mm in female, 3–6 mm in male. *Flowers* c. 5–7 mm diam. *Calyx* lobes 4–5 mm diam., subrotund to erose, pubescent without, pinkish, margin glandular-ciliate. *Petals* c. 5–7 mm long, subrotund, glabrous, creamy-white or pinkish. *Staminal tube* with small pore; anthers 6, c. 3 mm long, narrowly oblong, glabrous. *Capsules* borne towards tip of axis, 3–4 cm diam., glabrous, pink to dark red, white within. *Seeds* 1–3, c. 18 by 12 mm, plano-convex, covered with vermilion aril; testa dark brown to black. — **Fig. 29.**

Distribution — *Malesia:* Borneo (except south), Philippines (Palawan), Moluccas (Halmahera, *Whitmore 3616* in fruit) but not yet recorded from Celebes.

Habitat — Lowland and hill rain forest and heath forest, to 1800 m altitude.

Vernacular names — Ayam sabayan (Iban), lapunian batu (Kenyah).

Note — The leaflets somewhat resemble those of *A. sumatrana* with which it has been confused though that species has three anthers and was placed in '*Triandrae*' by

Harms, l.c. [= *Amoora* Roxb. sect. *Triamoora* Kuntze in Post & Kuntze, Lex. Gen. Phan. (1903) 24], the rest of the genus comprising '*Hexandrae*'.

3. **Aphanamixis sumatrana** (Miq.) Ridley

Aphanamixis sumatrana (Miq.) Ridley, Fl. Malay Penins. 1 (1922) 400; Mabb., Blumea 31 (1985) 139; in Tree Fl. Malaya 4 (1989) 231. — *Amoora sumatrana* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 35; C.DC. in DC., Monogr. Phan. 1 (1878) 581; King, J. As. Soc. Beng. 64, ii (1895) 52. — *Aphanamixis sumatrana* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296, nom. nud. — *Ricinocarpodendron sumatranum* (Miq.) Mabb., Mal. For. 45 (1982) 454.

Pachycaul treelet 2–6 m; bole 2–10 cm diam., often unbranched. Leafy *shoots* 10–25 mm diam., lenticellate. *Leaves* 50–110 cm, 4–6-jugate; glabrous to rarely leaflets finely puberulous abaxially; petiole 10–25 cm, 6–8 mm diam., ± lenticellate, terete, greatly swollen and flattened adaxially at base. *Leaflets* 8–30 by 3–10 cm, elliptic to oblanceolate-oblong, subcoriaceous, subbullate, bases attenuate, subequal, apices shortly cuspidate; petiolules 10–15 mm, the apical one to 60 mm, swollen; costae 15–20 on each side in largest leaflets, spreading, conspicuously looped well clear of margin. *Inflorescences* to 110 cm in female, 50 cm in male where branches to 15 cm, subsquarrose; axes finely adpressed pubescent; bracteoles c. 1 mm long, triangular pedicels c. 1 mm long, stout. *Flowers* c. 4 mm diam. *Calyx* lobes c. 2.5 mm diam., subrotund, ± pubescent without, glabrous within, reddish margin ciliolate, erose. *Petals* c. 4 mm diam., subrotund, ± puberulous without, glabrous within, cream or pinkish. *Staminal tube* with small pore; anthers 3, c. 3 mm long, boat-shaped, shortly apiculate, glabrous. *Capsules* borne towards tip of axis, 2–4 cm diam., glabrous, red, white within. *Seeds* 1–3, plano-convex.

Distribution — *Malesia:* Sumatra, Malay Peninsula.

Habitat — Lowland and hill rain forest, to 1000 m altitude.

Note — Sterile material is readily confused with that of some forms of *A. polystachya*.

AGLAIA

(C. M. Pannell)

Aglaia Lour., Fl. Cochinch. (1790) 173, nom. conserv.; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 140; Pannell, Kew Bull., Add. Ser. 16 (1992) 34 (see there for extra-Malesian synonymy).

Camunium [Rumph., Herb. Amboin. 5 (1747) 26, t. 18, f. 1 ex] Roxb., Fl. Ind. 2 (1824) 425, nom. illeg., non Adanson (1763).

[*Amerina* Noronha, Verh. Bat. Genoot. ed. 5, 1 (1790) 64, nom. nud., non Raf. (1838), nec A.P. DC. in Meissn. (1840).]

Andersonia Roxb., Fl. Ind., ed. 2, 2 (1832) 212, p.p. quoad *A. cucullata* Roxb. tantum, non R. Brown, Prodr. (1810) 553 (= *Epacridaceae*), nec Willd. ex Roem. & Schult., Syst. Veg. 5 (1819) 21 (= *Gaertnera* Lam., *Rubiaceae*).

Milnea Roxb. [Hort. Beng. (1814) 18, nom. nud.], Fl. Ind. 2 (1824) 430, non Raf. (1838).

Amoora Roxb., Pl. Corom. 3 (1820) 54, t. 258; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 128.

Nemedra A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 239.

Argophilum Blanco, Fl. Filip. (1837) 186.

Portesia Blanco, Fl. Filip. (1837) 296.

?*Selbya* M. Roem., Synops. Monogr. 1 (1846) 89, 126.
Beddomea Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 336.
Hearnia F. Muell., Fragm. Phyt. Austral. 5 (1865) 55.
Aglaiopsis Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 58.
Pistaciovitex Kuntze in T. Post & Kuntze, Lex. Gen. Phan. (1903) 442, excl. type.

Usually small to large trees, rarely bushes, with indumentum of stellate hairs or peltate scales; dioecious; trunk often with buttresses, bosses often present where branches have fallen off and these frequently bearing leafy shoots; crown sympodial: branched throughout or in the upper part only, or unbranched with a crown of leaves, branches usually ascending or patent or sometimes arching. Bark smooth or somewhat rough, sometimes (especially in the larger species) deciduous in squarish scales, usually with longitudinal rows of lenticels. Latex often present, sometimes flowing rapidly when the trunk is cut. *Twigs* stout or slender, usually greyish-brown, sometimes greenish-brown, yellowish-brown or reddish-brown, surface smooth or longitudinally wrinkled, apical bud without bud scales, made up of 2–4 unexpanded leaves which are spike-like, always with dense stellate hairs or peltate scales. *Leaves* borne in spirals, widely separated on the apical shoots or close together with the petiole bases overlapping, usually imparipinnate with lateral and terminal leaflets usually similar, the basal pair of leaflets rarely markedly smaller in size, leaves rarely simple. *Leaflets* (1–)3–25, the laterals usually subopposite, sometimes alternate, lanceolate, oblanceolate, ovate, obovate, elliptical or oblong, the lamina usually of moderate thickness, sometimes membranous or coriaceous, the surfaces usually smooth, one or both surfaces sometimes rugose, rugulose or pitted, the margin entire in plants of all ages, usually planar, sometimes recurved or slightly wavy, apex usually acuminate to caudate with the acumen obtuse or acute, rarely rounded, base rounded, subcordate, cuneate or attenuate, usually asymmetrical, in some species almost without indumentum but usually the lower surface with few, numerous or dense hairs or scales like those on the twigs; midrib and lateral veins usually prominent, subprominent or depressed, ascending, curved upwards near the margin and sometimes anastomosing, the reticulation occasionally subprominent on one or both surfaces, sessile or with a petiolule up to or rarely exceeding 25 mm. *Inflorescences* usually axillary or supra-axillary, occasionally ramiflorous or cauliflorous, often several on an apical shoot. *Flowers* unisexual with well developed rudiments of the opposite sex. Male inflorescence large, much divaricately branched, more or less triangular in outline, with small triangular or linear bracts which are often deciduous before maturity. *Flowers* up to 10,000, terminal on branchlets, solitary or in sessile clusters, sometimes with bracteoles similar to the bracts, usually smelling of citronella, minute, 1–6(–10) mm long, subglobose, ellipsoid or obovoid. Female inflorescence similar to the male but usually smaller and less-branched, sometimes a narrow spike-like raceme with few flowers; flowers often larger than in the male. *Calyx* 1/4–2/3 the length of the corolla, cup-shaped, often thickened at the base, shallowly or deeply 3–5- (or 6-)lobed, aestivation open or imbricate, the lobes unequal and sometimes patent at anthesis. *Corolla* aestivation imbricate or quincuncial, petals 3–5 (or 6), free or united at the base, free from the staminal tube or partially united to it, usually yellow, sometimes pink or

white, subrotund, elliptical or obovate, unequal, concave and usually thickest in the centre, often hooded at the apex when in bud, separating at anthesis, occasionally with stellate hairs or peltate scales on the outside. *Staminal tube* 0.5–8 mm long, more or less truncate at the base, usually subglobose, obovoid, cup-shaped, the apex incurved or rarely shortly cylindrical, without appendages, sometimes with stellate or simple hairs on the inner surface, aperture small to large with an entire, crenate or shallowly lobed margin; anthers (3–)5–10(–21), usually in a single whorl, rarely two or more overlapping whorls, occasionally with stellate or simple hairs, broadly or narrowly ovoid, dehiscing by two longitudinal slits, inserted on the inner surface of the tube either just below and protruding through the aperture and pointing towards the centre of the flower or more or less vertical against the inner surface of the tube, curved to follow the shape of the tube and partially or completely included, rarely inserted on the margin of the tube; anthers in the female flowers similar but sterile, usually not dehiscing and without pollen, rarely with a few misshapen pollen grains. Pollen 3- (? or 4-)corporate, 3–30 µm long, subprolate or prolate, exine smooth or rarely minutely scabrous, thickened at the apertures. *Disk* absent. *Ovary* 1–3(–10)-locular, superior, depressed-globose or ovoid with dense stellate hairs or peltate scales; locules with 1 or 2 collateral or superposed ovules, where carpels more than 1, placentation axial. Style a very short constriction between the ovary and style or absent. Stigma ovoid, more or less cylindrical or depressed-globose, often dark and shiny when mature, sometimes with longitudinal ridges, entire at the apex or with 2, 3 or rarely 4 small lobes, in one species (*A. parviflora*) the apex flattened and its margin raised and lobed; ovary and stigma in the male either poorly developed or similar to the female but sterile. *Infructescences* often several on a shoot with 1–c. 200 fruits. *Fruits* subglobose, obovoid or ellipsoid, indehiscent or a loculicidal capsule with 1–3 or rarely 4 or 10 locules each with one seed or rarely 2. *Seeds* large, usually with an aril or sarcotesta nearly or completely covering the seed. Embryo with thick plano-convex superposed or rarely oblique cotyledons, radicle included, the shoot axis with dense stellate hairs or peltate scales; endosperm absent. Germination semi-hypogeal, with hypocotyl undeveloped. First two leaves simple and opposite, subsequent leaves spirally arranged, simple at first, later 2- or 3-foliolate and increasing to or exceeding the number of leaflets present on the leaves of the mature plant.

Distribution — In total 105 species, of which 84 species in *Malesia*. From Sri Lanka and India through Myanmar (Burma), S China, and Taiwan, Indochina, Malaysia, Indonesia, the Philippines, New Guinea, Solomon Islands, Vanuatu (New Hebrides), New Caledonia, Australia (Queensland, Northern Territory and Western Australia), Fiji, east to the island of Samoa in Polynesia and north to the Marianne Islands (Saipan, Roti and Guam) and the Caroline Islands (Palau and Ponape) in Micronesia.

Habitat — Species of *Aglaia* form an important component of the moist tropical forest in the Indo-Malesian region. Some of the species are tall trees and occasionally emergent, some are undergrowth treelets, which may be unbranched, and others are rheophytes. At least two species, *A. elaeagnoidea* and *A. brownii*, are frequently and *A. lawii* is sometimes littoral; *A. cucullata* is found in tidal estuaries and mangrove swamps.

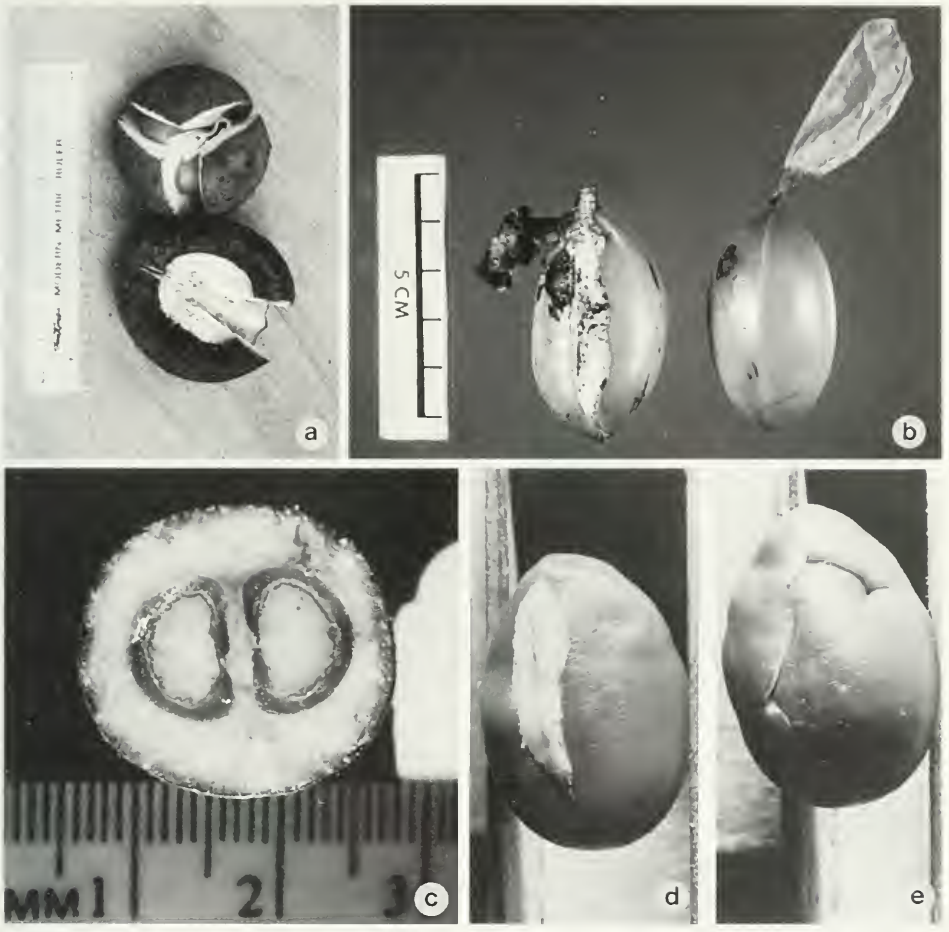

Fig. 30. *Aglaia*, fruits and seeds. — *A. erythrosperma* Pannell. a. Dehisced fruit; b. seeds (raphe and antiraphe sides), each with a complete aril, one with the membrane which surrounds the seed inside the fruit still attached. — *A. elliptica* Blume. c. Young fruit cut transversely, showing the thick pericarp with latex canals and the aril surrounding each seed. — *A. teysmanniana* (Miq.) Miq. d. Raphe side of the seed showing (white) the area of attachment to the pericarp; e. antiraphe side of the seed, showing the line along which the edges of the aril meet (in some seeds the aril does not meet and part of the testa remains exposed). a, b: Pasoh For. Res., Negri Sembilan, Malaysia; c–e: Kuala Lompat, Pahang, Malaysia. (a, b: *Pannell 1175*; c: *Pannell 1310*; d, e: *Pannell 1404*). Photographs C.M. Pannell, 1978–79.

Ecology — Pollinators unknown; field investigations by the author suggest small dipterans and possibly stingless bees [Pannell, Kew Bull., Add. Ser. 16 (1992) 14–16].

Dispersal is by vertebrates. See Pannell & Koziol, Phil. Trans. Roy. Soc. B 316 (1987) 303–333, where the investigation of 10 species is described. The seeds from dehiscent fruits (section *Amoora*) are dispersed mainly by birds and the arils are red-skinned, easily removed from the testa, rich in lipid (28–61% dry weight) and odour-

Fig. 31. *Aglaia elliptica* Blume. a. Female inflorescence; b. female flowers, showing quincuncial aestivation of corolla, the staminal tube in this species remaining concealed within the corolla at anthesis; c. germinating seeds, either the plumule emerges first (left, above) or the radicle (left, below); d. seedling in which the first two leaves are simple and opposite, the next three simple and alternate. Kuala Lompat, Pahang, Malaysia. (a, b: *Pannell 1279*). Photographs C.M. Pannell, 1978.

less. The aril in these species can be easily separated from the rest of the seed, and this probably means that it is easily removed by the action of the gizzard or gut of the dispersing birds, which regurgitate or pass the seeds unharmed. In species with indehiscent fruits the seeds are dispersed by primates and the arils are white, yellow, orange or

brown, gelatinous and translucent, firmly attached to the testa, high in sugars (16–26% dry weight) and in sweet-tasting amino acids (such as alanine, γ-aminobutyric acid, glycine, and asparagine or aspartic acid), relatively low in lipid (3–11%) and have a characteristic odour. The aril adheres firmly to the testa and this, together with its gelatinous nature, probably encourages primates to swallow the seeds or carry them away from the fruiting tree before eating the flesh and discarding the seed.

Several features in the position and architecture of the infructescence, and in the position, size and structure of the fruit are also related to the mode of dispersal. The red-skinned arils of dehiscent fruits contrast with the white inner pericarp which is exposed on dehiscence and the pink or brick-red outer surface of the pericarp; dehiscence of the fruit makes it possible for the seed to be extracted easily by the bill of a bird. Dehiscent fruits are borne in small numbers on infructescences which have a short, stiff peduncle, so that they remain close to the subtending twig or branch of the tree, which provides a perch for birds feeding on the arillate seeds.

When the fruits are large, the infructescences are borne on stout shoots; the seeds are large, and only large birds such as hornbills are able to swallow them. In species with smaller fruits, the infructescences are borne on slender shoots; it is more difficult, although still possible, for large birds to reach the fruits, but seeds are more frequently taken by smaller birds. Field observations suggest that the large-seeded dehiscent species of *Aglaia* are dispersed by hornbills and possibly fruit pigeons, and that the smaller-seeded species are dispersed by hornbills and an array of smaller birds, including bulbuls, broadbills and barbets. The small birds probably effect mainly local dispersal, but hornbills and pigeons are known to fly distances of 100 km or more and could be important in longer distance dispersal. The seeds are accessible to primates as well as birds, but there are no confirmed observations of primates feeding on seeds from species of *Aglaia* which have dehiscent fruits.

In indehiscent fruits the pericarp is orange, pinkish-orange or brown and they are borne near the ends of slender branches or in large hanging infructescences, sometimes with a long peduncle, where they can be reached and manipulated by long-armed and dexterous primates. The primates break open and peel off the pericarp and remove the seed. At least two species of monkey, the Banded Leaf Monkey [*Presbytis melalophus* (Raffles)] and the Long-tailed or Crab Macaque [*Macaca fasicularis* (Raffles)] and three species of ape, the Orang Utan (*Pongo pygmaeus abelii* Lesson), the Siamang [*Hylobates syndactylus* (Raffles)] and the White-handed Gibbon [*H. lar* (L.)], are known to ingest the seeds of *Aglaia*. In these indehiscent species, the seeds are inaccessible to most birds either because of the position of the infructescence or because the bird cannot manipulate the fruit to remove the pericarp and gain access to the seed.

Other animals in addition to primates might occasionally be dispersers in Sundaland, although they appear to be relatively unimportant. Squirrels are mainly destructive but occasionally disperse seeds over short distances. Terrestrial rodents and ground feeding birds such as the Crested Wood Partridge [*Rollulus rouloul* (Scopoli)] may play a similar role. Seeds of *Aglaia elaeagnoidea* have been found in the faeces of *Paradoxurus hermaphroditicus* (Pallas) (*Viverridae*, the civet family). Elephants, rhinoceros, tapirs and

some deer are known to feed on fallen fruits of other plant families and may also contribute to the dispersal of *Aglaia* seeds. Bat-dispersal is a possibility for some species.

The total geographical range of *Aglaia*, however, extends far beyond the eastern limits of the distribution of primates and of some of the bird families that are thought to be the main dispersal agents of *Aglaia* to the west of Wallace's Line. Species with dehiscent and indehiscent fruits occur east of Wallace's Line but the fruit structure, dehiscence and the aril type are known for only a few of these species.

Fruit pigeons, which occur throughout the range of *Aglaia* and some Australasian bird families such as the Birds of Paradise (*Paradisaeidae*), Bower Birds (*Ptilonorhynchidae*) and the flightless Cassowaries (*Casuariidae*) are likely to be dispersers in Australasia [see Pannell & White, Missouri Bot. Gard. Monogr. Syst. Bot. 25 (1988) 639–659]. Pigeons may have transported the seeds of *Aglaia* species with capsular fruits across Wallace's Line. They might therefore have played an important part in bringing about the collective geographical range of *Aglaia*, which lies entirely within the area of distribution of *Ducula* and *Ptilinopus*, the principal genera of fruit-eating pigeons in the Far East. Primates, which are important dispersers of the indehiscent species of *Aglaia* in Sundaland, are absent from Australasia and their role in dispersal may be filled there by terrestrial or arboreal fruit-eating marsupials, rodents, bats or ground-dwelling birds.

Chromosomes — The chromosomes are minute and the numbers are high; 2n = 64, 84 in the Malesian species examined by Pannell [Kew Bull., Add. Ser. 16 (1992) 21].

Uses — The wood of *Aglaia* is sometimes used locally for building or making furniture and the fleshy layer around the seeds of some species is edible, although inferior in quality to that of *Lansium domesticum* Correa agg., the Langsat. Trees of one species, *Aglaia korthalsii*, are grown for their fruits in villages in the state of Kelantan, Peninsular Malaysia. The flowers of *A. odorata* Lour. are used by the Chinese for scenting tea and in Java for scenting clothes (see under Cultivated species, below and p. 383). More recently investigation of the essential oil of the root bark of a species (incorrectly referred to as *A. odoratissima*) from Karnataka in India has revealed that the oil possesses antimicrobial and anthelmintic activities in vitro and that it has a depressant action on the central nervous system of mice [Nanda et al., Fitoterapia 58 (1987) 189–191]. See also the paragraph on Phytochemistry, p. 8.

Note — Two features of the genus make it particularly well suited for ecological study. First, *Aglaia* trees are rarely grown by man, so it can be assumed that trees growing in the forest are of wild origin. Second, there are usually several, and often as many as 12, species of *Aglaia* in a single forest site, which makes it possible to compare the reproductive biology of co-existing species and this contributes to an understanding of the plant and animal community of the forest as a whole. Studies of the reproductive biology of this large and common rain forest genus have therefore added to our general understanding of the role of animals as pollinators and dispersers of rain forest trees and of the relevance of this both to conservation and to the regeneration of tropical forest after logging. See Pannell in Silcock (ed.), The rainforests – A celebration (1989), chap-

ter 5; Pannell, Commonw. For. Rev. 68 (1989) 309–313. The study of the interdependence between plants and animals is one of the most important elements in understanding the forest ecosystem, crucial to both conservation and the sustainable management of forests, but it is an approach which has often been neglected. Further study of the complex species in this genus (*A. lawii, A. elaeagnoidea, A. korthalsii, A. leptantha, A. edulis, A. elliptica*, and *A. tomentosa*) is likely to prove to be particularly valuable, because they are often widespread and have apparently adapted to different physical and biotic conditions.

Cultivated species — The distribution of the type species of the genus, *Aglaia odorata* Lour., is China (Hainan), Vietnam, Cambodia and Thailand. It is cultivated in India, Sri Lanka, China, Sumatra, Malay Peninsula and Java, being usually a small bush, but sometimes a tree up to 10 m high. The 3–5 leaflets are small and glabrous with the reticulation subprominent on the lower surface. *Aglaia odorata* is planted in the grounds of Universiti Malaya, Kuala Lumpur and in the Bogor Botanic Gardens; in the latter, solitary trees are clipped into a neat dome and there is a hedge c. 3 m high. The female tree is rare in cultivation; the male is propagated by cuttings and bears flowers for much of the year. The flowers are strongly scented and used by the Chinese for scenting tea and by the Javanese for perfuming clothes.

KEY TO THE SPECIES

N.B.: The only characters for which sufficient comprehensively comparative information is available for use in a general key lie in the indumentum and in the flowers; both of these usually require magnification. When using this key, a binocular dissecting microscope should be used if possible. In the absence of a microscope, a × 20 hand lens is sufficient to reveal most of the characters in the key. As far as the author is aware, the morphology of the trichomes as described in this key is similar in fresh and dried material. Leaflet number and size have only been used near the final breaks in the key, where they reliably separate two closely related species. Characters of the flowers or fruits have only been used near the final breaks; if these are absent from the specimen being identified, the species descriptions should be referred to for deciding between the remaining small number of species.

1a. Leaf always a single blade 2
b. Leaves trifoliolate or imparipinnate 7
2a. Lower surface of leaf with numerous reddish-brown stellate hairs which are not deciduous . . . . . **80. A. integrifolia**
b. Lower surface of leaf with few or no hairs or scales (if numerous on young leaves, soon deciduous) 3
3a. Leaves linear-lanceolate, more than 4 times longer than wide . . **53. A. rivularis**
b. Leaves not linear-lanceolate, less than 4 times longer than wide (rarely one leaf on a specimen is slightly more than 4 times longer than wide) 4

4a. Indumentum of stellate hairs, sometimes with peltate scales interspersed 5
b. Indumentum of stellate and/or peltate scales only, stellate hairs absent 6
5a. Leaves with stellate hairs and peltate scales few to numerous on the midrib below; staminal tube appearing to be deeply lobed, the anthers continuous with the inner surface of the lobes, densely covered with simple yellow hairs on the margins of the lobes and on the anthers ..... **55. A. puberulanthera**
b. Leaves with reddish-brown stellate hairs and occasionally peltate scales; the indumentum dense on the twig apices and sparse elsewhere; staminal tube not deeply lobed, anthers and staminal tube not densely hairy ..... **71. A. simplicifolia**
6a. Leaves brown or greenish-brown when dry, indumentum of stellate and peltate scales, mainly on the midrib and veins on the lower surface of the leaves; inflorescence densely covered with peltate scales ..... **51. A. luzoniensis**
b. Leaves yellowish-green, pale green or pale brown when dry, with few small reddish-brown peltate scales on the midrib below; inflorescence with few to numerous peltate or stellate scales ..... **37. A. leucoclada**
7a. Leaflets with few or no hairs or scales on the lower surface, the reticulation continuous and subprominent on one or both surfaces 8
b. Leaflets with at least some scales or hairs on the lower surface, although these may be few and difficult to see, reticulation not continuous and subprominent on either surface, or if subprominent, then with indumentum on lower surface of leaflet 10
8a. Leaflets with reticulation subprominent on the lower surface ..... **66. A. cumingiana**
b. Leaflets with reticulation subprominent on both surfaces 9
9a. Leaflets 11–14, dull when dry ..... **67. A. laxiflora**
b. Leaflets 3–11, slightly shiny when dry ..... **70. A. oligophylla**
10a. Leaflets linear-lanceolate or narrowly elliptical, most being at least 5 times longer than wide 11
b. Leaflets ovate, elliptical, oblong, obovate, lanceolate or oblanceolate, most less than 5 times longer than wide 14
11a. Leaflets 3–5 ..... **52. A. yzermannii**
b. Leaflets 9–27 12
12a. Leaflets at least 10 times longer than wide, with reddish-brown stellate hairs numerous on the lower surface ..... **81. A. angustifolia**
b. Leaflets about 5 times longer than wide, with stellate hairs or scales or peltate scales few on or densely covering the midrib and few or absent on the lower surface 13
13a. Leaflets with reddish-brown stellate hairs or scales densely covering the midrib below, with 6–19 pairs of lateral veins ..... **62. A. elliptica**
b. Leaflets with few to densely covered with peltate scales which have a fimbriate margin on the midrib below; with 20–50 pairs of rather indistinct and widely spreading lateral veins ..... **8. A. multinervis**
14a. Indumentum dense, of white or pale brown hairs or scales which totally conceal the lower surface of leaflet 15

b. Indumentum reddish-brown or, if pale, not totally concealing the lower surface of leaflet 20
15a. Indumentum of hairs which have a central rachis and several whorls of arms radiating from it 16
b. Indumentum of stellate hairs or peltate scales 17
16a. Indumentum on lower surface of leaflet so dense that the surface is barely visible between the hairs even when using a hand lens; twigs and rachis channelled ..... **17. A. pachyphylla**
b. Indumentum dense but the lower surface visible between the hairs when using a hand lens; twigs and rachis terete ..... **15. A. grandis**
17a. Upper surface of leaflet rugose ..... **20. A. squamulosa**
b. Leaflet surfaces not rugose 18
18a. Indumentum dense on lower surface of leaflet, consisting of white peltate scales with few to numerous brown peltate scales interspersed ..... **19. A. argentea**
b. Indumentum dense on lower surface of leaflet, consisting of white stellate scales with few to numerous brown stellate hairs interspersed 19
19a. Upper surface of leaflet not shiny and reticulation not subprominent when dry ..... **18. A. eximia**
b. Upper surface of leaflet shiny and reticulation subprominent when dry ..... **17. A. pachyphylla**
20a. Lower surface of leaflet densely covered with reddish-brown or orange-brown hairs or scales, the surface not or barely visible between them 21
b. Hairs or scales absent from the lower surface or, when present, the lower surface of leaflet readily visible between them 24
21a. Lower surface of leaflet with numerous stellate hairs, with paler hairs which have one or few ascending arms interspersed, the surface barely visible in between ..... **82. A. hiernii**
b. Lower surface of leaflet densely covered with stellate or peltate scales, sometimes with stellate hairs interspersed, the surface not visible between them 22
22a. Lower surface of leaflet with dark reddish-brown entire peltate scales; flowers pentamerous; fruits indehiscent ..... **21. A. densisquama**
b. Lower surface of leaflet with reddish-brown stellate hairs, stellate scales or peltate scales which have a fimbriate margin; flowers trimerous; fruits dehiscent 23
23a. Twigs often densely covered with hairs which have a central rachis to 1 cm long and numerous whorls of arms radiating from it; lower surface of leaflet with dense stellate hairs and scales, sometimes completely or partly deciduous ..... **12. A. penningtoniana**
b. Twigs without hairs which have a central rachis to 1 cm long and numerous whorls of arms radiating from it; lower surface of leaflet densely covered with persistent stellate scales or peltate scales which have a fimbriate margin ..... **11. A. rubiginosa**
24a. Indumentum of peltate scales, sometimes with stellate scales interspersed 25
b. Indumentum of stellate hairs or scales; peltate scales absent 69

25a. Indumentum of peltate scales only 26
b. Indumentum of peltate and stellate scales (or with at least some of the scales with a long fimbriate margin) 60
26a. Scales densely covering lower surface of leaflet 27
b. Scales ± absent to numerous on lower surface of leaflet 31
27a. Leaflets densely covered with dark reddish-brown peltate scales which have a very dark, depressed centre (so that the scales resemble a minute volcano) ..... **26. A. smithii**
b. Peltate scales orange-brown, pale brown or almost white 28
28a. Twigs, inflorescence branches and lower surface of leaflets with scales all less than 0.25 mm in diameter, not shiny, scales pale brown . **44. A. crassinervia**
b. Twigs, inflorescence branches and lower surface of leaflets thickly covered with large, shiny, peltate scales at least some of which are 0.25 mm or more in diameter 29
29a. Upper surface of leaflet rugose ..... **20. A. squamulosa**
b. Upper surface of leaflet not rugose 30
30a. Leaflets (1–)3–7, scales orange-brown, pale brown or nearly white throughout ..... **25. A. elaeagnoidea**
b. Leaflets 7–11, with numerous to densely covered with pale orange-brown or reddish-brown peltate scales which have a dark centre and pale margin ..... **22. A. subcuprea**
31a. Scales few to numerous on lower surface of leaflet 32
b. Scales ± absent from lower surface of leaflet but may densely cover the midrib below and immediately adjacent to it and occasionally on the lateral veins 46
32a. Scales orange-brown, pale brown or almost white throughout 33
b. Scales at least partly reddish-brown 41
33a. Peltate scales evenly distributed on the lower surface of leaflet and visible to the naked eye as tiny dots 34
b. Peltate scales not evenly distributed on the lower surface of leaflet or if they are then not visible to the naked eye 39
34a. Leaflets markedly asymmetrical and often curved ..... **1. A. cucullata**
b. Leaflets only slightly asymmetrical and not curved 35
35a. Leaflets grey or brownish-green when dry, often coriaceous; twigs often stout 36
b. Leaflets orange, pale green or reddish-brown when dry, not coriaceous; twigs slender 38
36a. Flowers trimerous; fruit dehiscent ..... **2. A. flavida**
b. Flowers pentamerous; fruit indehiscent 37
37a. Leaflets with a recurved margin, with numerous large dark orange-brown peltate scales on the lower surface and visible to the naked eye as evenly distributed spots ..... **27. A. variisquama**
b. Leaflet margin not recurved, with numerous small yellowish-brown or orange-brown peltate scales which have an entire or fimbriate margin or almost stellate scales on the lower surface ..... **44. A. crassinervia**

38a. Fruit 2-locular, without prominent ribs ..... **28. A. rimosa**
b. Fruit 10-locular, with 10 prominent longitudinal ribs ..... **29. A. costata**
39a. Fruit dehiscent ..... **13. A. lawii**
b. Fruit indehiscent 40
40a. Leaflets with few to numerous small, reddish-brown, pale brown or orange-brown stellate hairs and scales or peltate scales on the midrib below; fruit large, up to 3.2 cm long and 3.8 cm in diameter, usually subglobose with an apical depression and 3-locular but sometimes the seed failing to develop in 1 or 2 of the locules; pericarp thick and woody ..... **48. A. edulis**
b. Leaflets with large pale brown or orange-brown peltate scales which are entire or have a fimbriate margin, few to numerous on lower leaflet surface; fruits small, to 2.5 cm long and 1.5 cm in diameter, subglobose, ellipsoid or obovoid without an apical depression, with 1 or 2 locules, the pericarp thin . **25. A. elaeagnoidea**
41a. Staminal tube with a narrow pin-prick aperture c. 0.3 mm across, with an entire margin, anthers included ..... **38. A. silvestris**
b. Staminal tube with the aperture wider than 0.3 mm, the margin shallowly lobed, anthers protruding through the aperture 42
42a. Leaflets usually markedly ovate, scales almost absent from the lower surface, veins often red when dry; fruit asymmetrically ellipsoid with one locule ..... **39. A. perviridis**
b. Leaflets elliptical, ovate or obovate, scales few to numerous on the lower leaflet surface, veins neither black nor red when dry; fruits symmetrical with 2 or 3 locules 43
43a. Leaflets narrowly elliptical or narrowly obovate, scales numerous on lower surface of leaflet ..... **31. A. speciosa**
b. Leaflets neither narrowly elliptical nor narrowly obovate, scales few to numerous on lower leaflet surface 44
44a. Lower surface of leaflet with few to numerous reddish-brown peltate scales which have a fimbriate margin and with paler scales interspersed; leaflet apex with a parallel-sided obtuse acumen ..... **41. A. cremea**
b. Lower surface of leaflet with peltate scales all of one type, or if paler scales interspersed then acumen not parallel-sided 45
45a. Leaflets usually 9–13 ..... **30. A. agglomerata**
b. Leaflets fewer than 9 ..... **32. A. korthalsii**
46a. Scales densely covering the midrib on lower surface of leaflet and immediately adjacent to the midrib, occasionally also on the lateral veins 47
b. Scales ± absent from lower surface of leaflet 54
47a. Scales large (many 0.2 mm across), orange-brown, reddish-brown or almost white, with a tendency to flake off 48
b. Scales less than 0.2 mm across or if larger, then dark reddish-brown or purplish-brown and adhering closely to the leaflet 50
48a. Leaflets with pale orange-brown or grey peltate scales few to numerous on the midrib on the lower surface ..... **24. A. lepiorrhachis**

b. Leaflets with numerous to densely covered with reddish-brown peltate scales on the midrib on the lower surface 49

49a. Peltate scales shiny orange-brown, often with a long fimbriate margin ..... **35. A. flavescens**

b. Peltate scales large, shiny and reddish-brown, either entire or with a short fimbriate margin ..... **23. A. lancilimba**

50a. Anthers and/or staminal tube with simple white hairs 51

b. Anthers and staminal tube without hairs 52

51a. Flowers with the staminal tube appearing to be deeply lobed, the anthers continuous with the inner surface of the lobes, densely covered with simple yellow hairs on the margins of the lobes and the anthers ..... **56. A. curyanthera**

b. Staminal tube neither deeply lobed nor densely hairy, but with some simple white hairs on the anthers ..... **36. A. samoensis**

52a. Leaflets with purplish-brown fimbriate peltate scales densely covering the midrib below and ± absent from the rest of the lower surface of the leaflet ..... **34. A. glabrata**

b. Leaflets with dark reddish-brown peltate scales numerous on the midrib below 53

53a. Leaflets (7–)9–13(–15), stellate scales absent ..... **33. A. scortechinii**

b. Leaflets 3–5(–7), some stellate scales interspersed among the peltate scales ..... **50. A. odoratissima**

54a. Veins usually black when dry; petals 5; fruit indehiscent ... **40. A. leptantha**

b. Veins rarely black when dry; petals usually fewer than 5; fruit dehiscent 55

55a. Leaflets markedly curved and asymmetrical ..... **1. A. cucullata**

b. Leaflets only slightly asymmetrical 56

56a. Ripe fruits up to 3.5 cm in diameter 57

b. Ripe fruits more than 3.5 cm in diameter 58

57a. Leaflets brown when dry, with few pale brown peltate scales which have a fimbriate margin and compact reddish-brown stellate hairs interspersed on the lower surface; colour of fruits when fresh not known, dark reddish-brown when dry ..... **9. A. lepidopetala**

b. Leaflets pale green or orange-brown when dry, with few to numerous almost white or pale orange peltate scales (rarely with a few hairs interspersed) on the lower surface; fruits pink, yellow, or carmine-red when fresh, pale brown or grey when dry ..... **13. A. lawii**

58a. Leaflets 15–25, lanceolate, veins 20–50 on each side of the midrib, indistinct ..... **8. A. multinervis**

b. Leaflets 7–15, ovate, obovate, elliptical or oblanceolate, lateral veins 6–20 on each side of the midrib 59

59a. Leaflet surfaces reddish-brown or orange-brown and often rugulose when dry, with few reddish-brown or grey peltate scales which have a fimbriate margin on the midrib below and often interspersed with minute reddish-brown pits ..... **3. A. macrocarpa**

b. Leaflets pale brown and not rugulose when dry, with small orange, orange-brown or pale brown peltate scales which have a dark central spot numerous on the midrib below, sometimes numerous on lower surface of leaflet but usually absent ... **2. A. flavida**

60a. Leaflets with numerous or densely covered with dark reddish-brown peltate scales and sometimes paler stellate scales on the midrib below, few to numerous on the rest of lower surface of leaflet; the staminal tube appearing to be deeply lobed, the anthers continuous with the inner surface of the lobes, densely covered with simple yellow hairs on the margins of the lobes and the anthers . **56. A. euryanthera**

b. Leaflets without or with few dark reddish-brown peltate scales, but with numerous pale brown or orange-brown peltate and stellate scales on the midrib below, few to numerous on the rest of lower surface of leaflet; the staminal tube neither deeply lobed nor densely hairy ... 61

61a. Leaflets with pale brown or reddish-brown peltate scales which have a fimbriate margin, numerous on or densely covering the midrib below, always with a few much darker peltate scales and dark reddish-brown pits interspersed, the inflorescence with reddish-brown stellate scales ... 62

b. Leaflets without dark reddish-brown peltate scales and dark reddish-brown pits, the indumentum usually brown or orange-brown, the pits, if present, orange-brown ... 63

62a. Leaflets pale bluish-green or yellowish green on both surfaces when dry ... **58. A. sapindina**

b. Leaflets dark brown when dry ... **57. A. polyneura**

63a. Leaflets pale yellowish-green when dry or with whitish-green or orange veins 64

b. Leaflets not pale yellowish-green when dry ... 67

64a. Fruit dehiscent (indicated in unripe fruits by the presence of three longitudinal ridges on the pericarp) ... **13. A. lawii**

b. Fruit indehiscent (any longitudinal markings on the fruits are slight depressions rather than ridges) ... 65

65a. Fruit subglobose with an apical depression or pyriform, pericarp thick (c. 3 mm) and woody ... 66

b. Fruits subglobose without an apical depression or obovoid, pericarp thin (c. 1 mm) ... **46. A. parviflora**

66a. Leaflets pale brown or yellowish-brown when dry; fruit usually subglobose and 3-locular but sometimes the seed failing to develop in 1 or 2 of the locules ... **48. A. edulis**

b. Leaflets yellow or yellowish-green when dry; fruits usually pear-shaped, sometimes subglobose and 2-locular ... **47. A. leucophylla**

67a. Staminal tube obovoid with a narrow aperture, anthers included or just protruding ... **54. A. brassii**

b. Staminal tube cup-shaped, anthers protruding ... 68

68a. Inflorescences always axillary; fruit ellipsoid, up to 2 cm long ..... **50. A. odoratissima**
b. Inflorescences ramiflorous and axillary; fruit pyriform, up to 4.5 cm long ..... **49. A. macrostigma**
69a. Leaflets with few to densely covered with stellate hairs or scales on the lower surface; when sparse, some hairs or scales occur evenly distributed between the veins and their presence visible with the naked eye 70
b. Leaflets without or with few hairs on the lower surface, with scales visible only with a lens or densely covered with hairs on the midrib only, few and unevenly scattered on the rest of the lower surface 88
70a. Reticulation subprominent on both surfaces of leaflet when dry; with some hairs (on the twigs and sometimes elsewhere) which have a central rachis and several whorls of arms radiating from it ..... **16. A. ramotricha**
b. Reticulation not subprominent; all hairs lacking a central rachis 71
71a. Hairs pale yellowish-brown or if reddish-brown then flower trimerous 72
b. Hairs reddish-brown or brown, or if pale brown then flower pentamerous ... 74
72a. Leaflets 11–13 ..... **10. A. densitricha**
b. Leaflets 1–9, rarely 11 73
73a. Peltate scales absent ..... **14. A. teysmanniana**
b. Peltate scales present, at least on the shoot apex ..... **13. A. lawii**
74a. Hairs on lower leaflet surface numerous and with the arms of adjacent hairs overlapping, but leaving the surface of the leaflet visible 75
b. Hairs on lower surface of leaflet few or at least with the arms not usually overlapping 79
75a. Hairs compact with arms all ± equal in length c. 0.5 mm, brown, densely covering the midrib, densely covering or scattered on the rest of the lower surface of leaflet 76
b. Hairs large and spreading, arms unequal in length up to 1 mm long and in some species (e.g. *A. rufibarbis*) up to 4 mm, usually reddish-brown and numerous on lower surface of leaflet 77
76a. Lower surface of leaflet densely covered with persistent brown stellate hairs and scales ..... **45. A. sexipetala**
b. Lower surface of leaflet densely covered with brown stellate hairs which are deciduous and leave numerous pits and an uneven indumentum most dense near the midrib and veins ..... **42. A. forbesii**
77a. Stellate hairs with long arms, up to 4 mm ..... **84. A. rufibarbis**
b. Stellate hairs with arms not usually exceeding 1 mm in length 78
78a. Lower surface of leaflet with numerous stellate hairs, the arms of adjacent hairs overlapping, interspersed with some pale brown hairs which have one or few ascending arms; fruit up to 5 cm long and 3.5 cm wide, with a hard woody pericarp 2–4 mm thick ..... **82. A. hiernii**

b. Lower surface of leaflet with numerous stellate hairs, the arms of adjacent hairs overlapping, interspersed with pale brown stellate hairs which have several ascending arms; fruit up to 2.5 cm long and 1.7 cm wide, with a thin brittle pericarp less than 2 mm thick ..... **79. A. tomentosa**

79a. Leaflets with indumentum of few fimbriate peltate scales and stellate hairs on the lower surface; fruits small, up to 4 mm in diameter, hairs few or absent ..... **77. A. palembanica**

b. Peltate scales absent from lower surface of leaflet; fruits 1 cm or more in diameter, with dense indumentum 80

80a. Leaflets usually more than 11, elliptical or oblong, the arms of adjacent hairs on lower surface not overlapping 81

b. Leaflets rarely more than 11, most obovate, if more than 11 then the indumentum dense and arms of adjacent hairs on lower surface overlapping 83

81a. Leaflet surfaces not rugulose and without pits, leaflets up to 4 cm wide ..... **76. A. exstipulata**

b. Upper surface of leaflet rugulose and pitted, lower surface with numerous pits, leaflets up to 8 cm wide 82

82a. Hairs and scales mostly reddish-brown ..... **75. A. rufinervis**

b. Hairs and scales mostly orange-brown ..... **47. A. leucophylla**

83a. Usually unbranched tree 84

b. Tree branching several or many times when mature 85

84a. Leaflets usually pale green when dry, with numerous reddish-brown stellate hairs on lower surface, not glabrescent; inflorescences axillary . **73. A. tenuicaulis**

b. Leaflets usually bluish-green when dry, with numerous to densely covered with orange-brown stellate hairs on the midrib below, interspersed on the lower surface with paler stellate hairs which have fewer arms, glabrescent; inflorescences ramiflorous ..... **59. A. ceramica**

85a. Leaflets with 23–47 pairs of veins, with few stellate hairs on the lower surface .. .. **74. A. membranifolia**

b. Most leaflets with fewer than 23 lateral veins, with numerous hairs or scales on the lower surface 86

86a. Leaflets with numerous pale stellate scales on the lower surface, interspersed with reddish-brown stellate hairs which have arms of different lengths .... **79. A. tomentosa**

b. Leaflets with numerous pale brown or reddish-brown stellate hairs which have arms of similar lengths on the lower surface 87

87a. Leaflets with reddish-brown stellate hairs interspersed with paler brown stellate hairs on the lower surface, reticulation same colour as rest of lower surface of leaflet ..... **73. A. tenuicaulis**

b. Leaflets with pale brown stellate hairs interspersed with pale brown stellate scales on the lower surface, reticulation white or pale brown on the lower surface when dry ..... **78. A. brownii**

88a. Lower surface of leaflet with numerous stellate or peltate scales 89
b. Leaflets with hairs or scales few on the lower surface between the veins when mature, but sometimes densely covering the midrib 93
89a. Upper and lower surfaces of mature leaflets with numerous stellate scales which have a pale margin ..... **68. A. pyriformis**
b. Scales stellate of uniform colour, scales usually absent from upper surface of mature leaflets 90
90a. Stellate scales interspersed with compact stellate hairs .... **45. A. sexipetala**
b. Scales peltate, often with a fimbriate margin, if scales stellate then stellate hairs absent 91
91a. Fruit dehiscent ..... **13. A. lawii**
b. Fruit indehiscent 92
92a. Scales all of one type ..... **44. A. crassinervia**
b. Stellate and peltate scales present together ..... **47. A. leucophylla**
93a. Stellate hairs or scales more than 0.15 mm in diam., numerous on or densely covering the midrib, sometimes also on the lateral veins, almost absent elsewhere 94
b. Stellate hairs or scales either very small, less than 0.15 mm in diameter, or almost totally absent from the midrib below and from the rest of the lower surface of leaflet 109
94a. Leaves ± sessile or with a short peduncle of not more than 1 cm; the basal part of leaflets much smaller than the rest and subrotund ..... **61. A. subsessilis**
b. Leaves not sessile, the basal leaflets only slightly smaller than the rest and of similar shape 95
95a. Reticulation subprominent on lower surface and often on upper surface of leaflet 96
b. Reticulation may be visible, but not subprominent 97
96a. Leaflets 11–14, with pale brown stellate scales few to numerous on the midrib below, reticulation subprominent above and below ..... **67. A. laxiflora**
b. Leaflets 3–11, with pale yellowish-brown stellate hairs absent to numerous on the midrib below, reticulation visible on the upper surface, subprominent below ..... **70. A. oligophylla**
97a. Petals 3, densely covered with stellate scales on the outside; fruits dehiscent ... . **9. A. lepidopetala**
b. Petals 5, without scales on the outside, fruits indehiscent 98
98a. Tree unbranched; leaflets shiny ..... **69. A. coriacea**
b. Tree branched; leaflets not shiny 99
99a. Fruit c. 0.5 cm in diameter, with few stellate scales ..... **64. A. aherniana**
b. Ripe fruit 1 cm or more in diameter, with dense indumentum 100
100a. Leaflet apex with a parallel-sided acumen 101
b. Leaflet apex with a tapering acumen 102
101a. Leaflets coriaceous ..... **42. A. forbesii**
b. Leaflets not coriaceous ..... **40. A. leptantha**

102a. Both surfaces of leaflet with prominent pits ..... **43. A. foveolata**
b. Leaflets not prominently pitted although may be faintly so 103
103a. Stellate hairs with long arms up to 6 mm, conspicuous on stems and on the midrib below, few or absent elsewhere ..... **83. A. cuspidata**
b. All arms of hairs less than 4 mm long 104
104a. Fruit with one or more longitudinal ridges 105
b. Fruit without longitudinal ridge(s) 107
105a. Fruit with three longitudinal ridges running base to apex, dehiscent **13. A. lawii**
b. Fruit with two or ten longitudinal ridges from base to apex, indehiscent ... 106
106a. Fruit obovoid or ellipsoid with two longitudinal ridges (i.e. one ridge completely encircling the fruit longitudinally) ..... **62. A. elliptica**
b. Fruit narrowly ellipsoid with longitudinal ridges ..... **61. A. subsessilis**
107a. Fruit up to 5.5 cm long and 4 cm wide ..... **63. A. cinnamomea**
b. Fruits less than 2.5 cm long and 2.5 cm in diameter 108
108a. Leaflets with dark orange or reddish-brown stellate hairs or scales few on or densely covering the midrib below, few to numerous on the lateral veins ..... **60. A. subminutiflora**
b. Leaflets rarely with hairs or scales on the lateral veins .. **65. A. barbanthera**
109a. Petals 5; leaflets yellow or yellowish-green or the veins black or dark brown when dry 110
b. Petals 3; leaflets brown, greenish-brown, purplish-brown or orange-brown, veins usually the same colour as the leaflet surface 114
110a. Leaflets greyish-brown or black when dry, particularly the veins; scales pale grey or greyish-brown 111
b. Leaflets yellow or yellowish-green when dry; hairs or scales pale brown, reddish-brown or golden brown 112
111a. Flowers usually with shallow, cup-shaped staminal tube which has a wide aperture; leaflets usually slightly pitted, pale brownish-green when dry, subcoriaceous with stellate scales on lower surface, few on or densely covering the midrib and few elsewhere, veins 13–18 pairs, often black but reticulation not conspicuous ..... **42. A. forbesii**
b. Flowers usually with obovoid staminal tube which has a minute apical pore; the leaflets usually smooth, brownish-green or blackish-green when dry, thin; veins 4–14 pairs, the midrib, lateral veins and reticulation black when dry ..... **40. A. leptantha**
112a. Inflorescence delicate, peduncle, rachis and branches flattened, these and calyces with very few pale brown or nearly white stellate scales . **66. A. cumingiana**
b. Inflorescence robust, the peduncle, rachis and branches terete, with numerous to densely covered with orange-brown or reddish-brown hairs or scales 113
113a. Leaflets 9–15(–17), rounded or cuneate at the base, margins not recurved when dry, with few to numerous golden-brown scales on the lower surface ..... **47. A. leucophylla**

b. Leaflets (1–)3–5, cuneate or attenuate at the base, margins recurved, with reddish-brown stellate hairs on the twig apices and ± absent from the mature leaflets ..... **72. A. monozyga**

114a. Leaflet surfaces dull and pitted, with tiny stellate hairs sometimes frequent on lower surface, reticulation subprominent ..... **7. A. spectabilis**

b. Leaflet surfaces smooth or rugulose but not pitted, stellate hairs almost absent from lower surface, reticulation not subprominent 115

115a. Leaflets 2–4 cm wide, lower surface usually purplish-brown and smooth when dry ..... **4. A. malaccensis**

b. Leaflets 6–12 cm wide, lower surface not purplish-brown when dry 116

116a. Both leaflet surfaces smooth or only slightly rugulose, base usually rounded, sometimes cuneate on some of the leaflets ..... **6. A. erythrosperma**

b. Upper and lower surfaces of leaflet rugulose, base cuneate or attenuate 117

117a. Small tree, up to 12 m; twigs with a few white or reddish-brown stellate hairs; leaflets 7–9(–15), base attenuate ..... **5. A. rugulosa**

b. Tall tree, up to 45 m; twigs densely covered with hairs which have a central rachis and numerous whorls or arms radiating from it, these often deciduous, exposing numerous pale brown or dark reddish-brown stellate hairs and scales; leaflets 11–13, rounded or slightly cuneate at the base ..... **12. A. penningtoniana**

Section Amoora

Aglaia sect. *Amoora* (Roxb.) Pannell, Kew Bull., Add. Ser. 16 (1992) 58. — *Amoora* Roxb., Pl. Coromandel 3 (1820) 54, t. 258. — *Amoora* sect. *Amoora*, Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 37 ('*Otamoora*').

Calyx with 3 (or 4) broad obtuse lobes. *Petals* 3(–5), aestivation usually imbricate, quincuncial when petals 5. *Anthers* 6–21. *Ovary* usually with 3, rarely 4, locules. *Fruit* dehiscent; aril opaque, with red, white or yellow outer skin, flesh solid or of a milky consistency.

Note — The maximum of 21 anthers is found in *Aglaia penningtoniana*; *A. lawii* usually has 4 petals and *A. teysmanniana* 3–5. The largest trees in the genus belong to this section and they often attain or emerge from the canopy layer of the forest. *Aglaia lepidopetala* and *A. rugulosa* are smaller, rarely exceeding 10 m, while *A. lawii* and *A. teysmanniana* grow to 30 m and 15 m respectively. The fruits of the larger species and of *A. rugulosa* are large and heavy and the twigs are stout. In *A. lepidopetala*, *A. lawii* and *A. teysmanniana* the fruits are smaller and the twigs are relatively slender. In most species, the leaflets are coriaceous and, in some, the indumentum on the leaves is inconspicuous and easily overlooked without magnification. *Aglaia rubiginosa*, *A. densitricha* and sometimes *A. penningtoniana* have a dense reddish-brown indumentum. *Aglaia lawii* varies from having almost none to numerous peltate scales on the lower leaflet surface and there is similar variation in stellate hairs in *A. teysmanniana*. The flowers are relatively large in *A. rubiginosa* (up to 9 mm long) and *A. penningtoniana* (up to 10 mm long). They rarely exceed 6 mm in the rest of the genus.

1. Aglaia cucullata (Roxb.) Pellegr.

Aglaia cucullata (Roxb.) Pellegr. in Fl. Indo-Chine 1 (1911) 771; Pannell in Tree Fl. Malaya 4 (1989) 214; Kew Bull., Add. Ser. 16 (1992) 58, f. 3. — *Amoora cucullata* Roxb., Pl. Coromandel 3 (1820) 54, t. 258; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 37; King, J. As. Soc. Beng. 64, ii (1895) 55; Ridley, Fl. Malay Penins. 1 (1922) 399; Backer & Bakh. f., Fl. Java 2 (1965) 126. — *Andersonia cucullata* Roxb., Fl. Ind., ed. Carey, 2 (1832) 212.

[*Amoora auriculata* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 37, nom. in syn.]

Amoora aherniana Merr., Philipp. Govt. Lab. Bur. Bull. 17 (1904) 24.

Aglaia tripetala Merr., J. Str. Br. Roy. As. Soc. 76 (1917) 88.

[*Aglaia conduplifolia* Elmer, Leafl. Philipp. Bot. 9 (1937) 3324, sine diagn. lat.]

Tree up to 15(–30) m, with a broad rounded crown. Bole up to 10 m, up to 100 cm in diam., sometimes with plank buttresses to 3 m high, sometimes with pneumatophores up to 7 m away from the bole and up to 60 cm high. Bark smooth, brown, pinkish-grey or pale orange-brown, sometimes flaking in small brittle or papery scales; inner bark pink, fibrous; sapwood pale yellowish-brown, pink or orange-brown; latex white. *Twigs* slender, densely covered with pale brown or almost white peltate scales which are darker in the centre and have a paler, sometimes (always in New Guinea) fimbriate, margin. *Leaves* imparipinnate, up to 45 cm long and 40 cm wide; petiole up to 15 cm, petiole, rachis and petiolules with the surface and a few peltate scales like those on the twigs. *Leaflets* 5–9, 4–20 by 1.5–6 cm, subcoriaceous, ovate, asymmetrical and curved, acuminate at apex, rounded at the markedly asymmetrical base, the terminal leaflet sometimes reduced in size to c. 4 by 1.5 cm, with a petiolule up to 4 cm long and the lamina folded at the base of the leaflet to form a pocket on the upper surface, lower surface rugulose and faintly pitted, with a few scales on the midrib and veins like those on the twigs and sometimes scattered on the surface in between; veins 8–13 on each side of the midrib, the reticulation visible on both surfaces; petiolules up to 10(–15) mm. *Inflorescence* up to 30 cm long and 35 cm wide; peduncle up to 8 cm, peduncle, rachis and branches flattened with few to numerous scales like those on the twigs. *Flowers* up to 3.5 mm long and 3.5 mm wide; pedicel up to 3 mm with numerous scales like those on the twigs. *Calyx* with few to numerous white stellate scales on the outside. *Petals* 3, glabrous. *Staminal tube* slightly shorter than the corolla, the aperture up to 1.5 mm across and shallowly 6-lobed; anthers 6, ellipsoid, protruding slightly through the aperture. *Infructescence* with few fruits; peduncle c. 5 cm. *Fruits* c. 7 cm long and 6 cm wide, yellow, obovoid; pericarp leathery, thin, brittle and moulded around the seeds when dry, densely covered with reddish-brown peltate scales which have a fimbriate margin. Locules (2 or) 3, each containing 0 or 1 seed. *Seeds* c. 5 by 3 cm, with a shiny, reddish-brown, yellow or white aril covering about half the seed.

Distribution — Bangladesh (Ganges delta), Thailand, Vietnam (Mékong delta); *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Borneo, Java, Philippines, New Guinea.

Habitat & Ecology — Riverine forest, tidal estuaries, mangrove, nipah swamp; 0–20 m altitude; scarce to rather common. The pouch at the base of the terminal leaflet is sometimes occupied by ants. The presence of a fleshy aril around the seed suggests that dispersal is by animals (probably birds) but, given the habitat and widespread distribution of the species, the possibility of dispersal by water should also be investigated.

Uses — Wood used for posts and firewood; the resinous pericarps are sometimes used in the Philippines for illuminating purposes [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 137, under *Amoora aherniana*, 138]. Wood used for building in Brunei and building boats in Irian Jaya (Merau river).

Notes — 1. The leaflets of *Aglaia cucullata* are curved, markedly asymmetrical and almost without indumentum.

2. The terminal leaflet sometimes has a pouch at the base of the lamina which gives the species its name and resembles that found on the leaf of *Ficus benghalensis* L. var. *krishnae* (C.DC.) Corner.

3. *Aglaia cucullata* is the only species of the genus which grows in estuaries and mangrove swamps and the only species for which pneumatophores are recorded.

2. **Aglaia flavida** Merr. & L.M. Perry

Aglaia flavida Merr. & L.M. Perry, J. Arnold Arbor. 21 (1948) 320; Pannell, Kew Bull., Add. Ser. 16 (1992) 64.

Aglaia cucullata auct. non (Roxb.) Pellegr.: Henty, Bot. Bull. Lae 12 (1980) 100, t. 59.

Tree up to 36 m, girth up to 3 m; buttresses broad, steep, to 60 cm out and to 3 m high, or narrow, plank-like and equal. Bark white, grey, pale, dark or reddish-brown, firmly fibrous, smooth or fissured and pitted, with scales either adherent or sloughing in medium-sized pieces which leave scroll marks on the bole; sapwood hard or soft, pale reddish-brown, reddish-brown, deep red or yellowish-brown; sometimes with white latex. *Twigs* stout, densely covered with small orange, orange-brown or pale brown peltate scales which have a fimbriate margin and often have a dark central spot, sometimes with a few darker scales interspersed. *Leaves* up to 82 cm long and 55 cm wide; petiole 10–22 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 7–15, 9.5–30 by 4–10.5 cm, pale brown when dry, acuminate or rounded at the apex, cuneate or rounded at the sometimes markedly asymmetrical base, with numerous scales like those on the twigs on the midrib below and scattered on the rest of the lower leaflet surface, sometimes with numerous pale scales which are visible with the naked eye on dried specimens and a few brown scales like those on the twigs; veins 6–20 on each side of the midrib; petiolules 5–20(–25) mm. *Inflorescence* 26–42 cm long, c. 24 cm wide; peduncle 1.5–19 cm, peduncle, rachis and branches with numerous scales like those on the twigs. *Flower* 2.5 mm long, 2 mm wide; sessile or with a pedicel up to 0.5 mm. *Calyx* densely covered on the outside with brown scales like those on the twigs. *Petals* 3, with some stellate scales on the outside. *Staminal tube* c. 2 mm long, subglobose, anthers 6, about 2/3 the length of the tube and just protruding. *Infructescence* c. 20 cm long and 7 cm wide; peduncle c. 7 cm, the peduncle, rachis and branches densely covered with pale and reddish-brown scales which have a fimbriate margin. *Fruits* up to 8 by 2.5–5.5 cm, subglobose or obovoid, orange or brown, dehiscent, densely covered on the outside with scales like those on the twigs; fruit-stalk 1–4 cm. Locules 3, each containing 0 or 1 seed; aril white.

Distribution — Solomon Islands; *Malesia:* New Guinea, New Britain.

Habitat & Ecology — Found in primary lowland and hill forest, secondary forest, on occasionally inundated soil to well-drained soil, on clay, peat, coral; from sealevel up to 1300 m; common. Fruits eaten by birds.

Uses — Wood is used for houses, paddles (Irian Jaya: Asmat); axe handles (Solomon Islands: New Georgia); canoes (Solomon Islands: Guadalcanal).

Notes — 1. *Aglaia flavida* is similar to *A. macrocarpa*. They differ in details of the trichome structure, pigmentation and distribution and in the texture of the leaflet surfaces. *Aglaia macrocarpa* does not occur east of the Moluccas, whereas *A. flavida* is confined to New Guinea, New Britain, and the Solomon Islands.

2. The sap is irritant and may cause severe dermatitis (Henty 1980, sub *A. cucullata*).

3. Aglaia macrocarpa (Miq.) Pannell

Aglaia macrocarpa (Miq.) Pannell, Kew Bull., Add. Ser. 16 (1992) 65, f. 6. — *Epicharis macrocarpa* Miq., Fl. Ind. Bat., Suppl. (1861) 196, 505.

[*Aglaia pycnocarpa* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 45, nom. superfl., illegit.]

Amoora rubescens Hiern in Hook. f., Fl. Brit. India 1 (1875) 561; King, J. As. Soc. Beng. 64, ii (1895) 57; Ridley, Fl. Malay Penins. 1 (1922) 399. — *Aglaia rubescens* (Hiern) Dai, Biol. Rev. (Vietnam) 1, 4 (1979) 23; Pannell, Mal. For. 45 (1982) 455; in Tree Fl. Malaya 4 (1989) 223.

Amoora trichanthera Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 123; Koord., Atlas 1 (1913) t. 163; Backer & Bakh. f., Fl. Java 2 (1965) 126. — *Aphanamixis trichanthera* (Koord. & Valeton) Koord., Exk. Fl. Java 2 (1912) 444.

Aglaia trimera Ridley, Kew Bull. (1930) 368, nom. illeg., non Merr. (1929). — *Aglaia triplex* Ridley, Kew Bull. (1938) 215.

Tree up to 35 m. Bole up to 22 m, 150 cm in circumference, with buttresses outwards up to 100 cm. Bark reddish-brown and grey or pale, flaking in large irregular scales and numerous reddish-brown lenticels, some in longitudinal rows; inner bark dark red or pinkish-brown; sapwood pale yellow, pale or dark yellowish-brown or pale reddish-brown; latex white. *Twigs* fairly stout, densely covered with minute reddish-brown or grey peltate scales which have a fimbriate margin and are deciduous, leaving dark reddish-brown pits. *Leaves* imparipinnate, up to 70 cm long and 50 cm wide; petiole up to 20 cm, flattened on the adaxial side, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 11–15, 5–25 by 2–7 cm, pale reddish-brown when dry, coriaceous, acuminate or caudate at apex, rounded or cuneate at the asymmetrical base, upper surface rugulose, shiny, lower surface rugulose with few minute reddish-brown scales or numerous pale grey peltate scales on the midrib and lateral veins, often interspersed with minute reddish-brown pits; veins 6–11 on each side of the midrib, lower surface with midrib and lateral veins with longitudinal wavy ridges, midrib prominent and lateral veins slightly prominent; petiolules up to 15(–20) mm. *Inflorescence* up to 30 cm long and 20 cm wide; peduncle up to 11 cm, peduncle, rachis, branches and pedicels with indumentum like the twigs. *Flowers* dark yellow, up to 3.5(–5) mm long; sessile or with pedicel up to 1(–3) mm. *Calyx* densely covered on the outside with dark brown stellate scales. *Petals* 3, densely covered on the outside when young with dark brown stellate scales which are deciduous at maturity. *Staminal tube* shorter than the corolla, subglobose, with the aperture c. 1 mm across, and shallowly and irregularly

lobed; anthers 6–10, and half to as long as the tube, ellipsoid or narrowly ovoid, curved with the tube and just protruding beyond the aperture, usually with scattered simple hairs. *Infructescence* with about 4 fruits; peduncle 3.5–8 cm, peduncle, rachis and branches stout and with surface and indumentum like the twigs. *Fruits* up to 6 by 5.5 cm, obovoid, the pericarp longitudinally wrinkled and moulded around the seeds when dry, densely covered with dark reddish-brown stellate scales; fruit-stalk up to 1 cm. Locules 3, each containing 0 or 1 seed. *Seeds* with a complete red, orange or white aril, c. 5.5 cm long, 2.5 cm wide and 1.5 cm thick; testa brown.

Distribution — Vietnam; *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Borneo, Java, ?Philippines (Palawan), Celebes, ?Moluccas (Ceram, Halmahera).

Habitat — Found in lowland, hill and ridge forest, primary forest, secondary forest, pole forest and along rivers and paths; on sandy clay, sandstone, loam, limestone and basalt. Altitude from sealevel up to 1750 m.

Notes — 1. It is sometimes difficult to separate *A. macrocarpa* from *A. malaccensis* and they may represent a single variable species. The leaves of *A. macrocarpa* are usually orange-red when dry and the leaflet base is more cuneate than in *A. malaccensis*. Upper and lower surfaces are rugulose and there are fewer pairs of veins. The fruit is obovoid.

2. High altitude specimens have shiny, coriaceous leaves. Low altitude specimens exhibit two different indumentum types: minute reddish-brown peltate scales or grey peltate scales which have a fimbriate margin, either of these may be deciduous and leave dark reddish-brown pits. Trees with the different indumentum types are distinguishable in the field when they occur at the same site (e.g. East Kutei, Kalimantan, M. Leighton, pers. comm.). It has not, however, been possible to distinguish them with certainty in the herbarium, except from the minute scale character. Further field work and improved collections may result in the discovery of more easily observed distinguishing characters.

4. Aglaia malaccensis (Ridley) Pannell

Aglaia malaccensis (Ridley) Pannell, Mal. For. 45 (1982) 455; in Tree Fl. Malaya 4 (1989) 219; Kew Bull., Add. Ser. 16 (1992) 70, f. 7. — *Amoora malaccensis* Ridley, J. Str. Br. Roy. As. Soc. 75 (1917) 16; Fl. Malay Penins. 1 (1922) 399.

Tree up to 27 m. Bole up to 165 cm in circumference, with a few thick, shallow buttresses upwards up to 50 cm. Bark smooth, pale brown with longitudinal rows of lenticels, flaking in large scales of irregular size up to 65 cm long and 35 cm wide; sapwood soft, fibrous, pink, yellow or white; latex white. *Twigs* fairly stout, densely covered with small pale brown or almost white stellate hairs or scales. *Leaves* imparipinnate, up to 50 cm long, 20 cm wide; petiole up to 20 cm, flattened on the adaxial side, petiole, rachis and petiolules with surface and indumentum like the twigs. *Leaflets* 11–15, 7–15 by 2–4 cm, green above and dark purplish-brown below when dry, usually lanceolate, sometimes oblong or elliptical, acuminate at apex, rounded at the asymmetrical base with very small scales like those on the twigs on the lower surface, which are numerous on or densely covering the midrib and few to numerous on the lower leaflet surface; veins 10–16 on each side of the midrib, lower surface with midrib and lateral veins both lon-

gitudinally wrinkled; petiolules up to 15(–20) mm. *Inflorescence* up to 25 by 15 cm; peduncle up to 10 cm, peduncle, rachis and branches somewhat flattened, and with indumentum like the twigs. *Flowers* up to 3 mm long and 2.5 mm wide; pedicel c. 1 mm. *Calyx* densely covered with stellate scales on the outside. *Petals* 3, densely covered with stellate scales on the outside. *Staminal tube* about 2/3 the length of the corolla, obovoid or cup-shaped, the apical margin shallowly divided into c. 6 acute lobes; anthers 6(–7), as long as the tube, narrowly ellipsoid, just protruding beyond the aperture of the tube. *Infructescence* with few fruits. *Fruits* up to 6 cm long, 7 cm wide, reddish-brown, depressed globose, densely covered with hairs and scales like those on the twigs on the outside; latex white. Locules 3 or 4, each containing 0 or 1 seed. *Seeds* 3.5–3.8 cm long, c. 2 cm wide, 1.5 cm through, totally covered with a red or yellow aril 1–2 mm thick.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines.

Habitat & Ecology — Found in primary and secondary forest on clay, shale, sand and loam; altitude 12 to 700 m; rare and scattered to common. ?Fruits eaten by monkeys.

Note — When dry, the leaflets of *Aglaia malaccensis* are usually green above and purplish-brown below, they are rarely rugulose and the lateral veins are more numerous and more prominent than in *A. macrocarpa*. *Aglaia malaccensis* has pale stellate scales or hairs whereas *A. macrocarpa* has minute peltate scales which have a fimbriate margin and these leave dark reddish-brown pits after they are shed. The fruit of *A. malaccensis* is depressed globose, whereas that of *A. macrocarpa* is obovoid.

5. **Aglaia rugulosa** Pannell

Aglaia rugulosa Pannell, Kew Bull., Add. Ser. 16 (1992) 73, f. 9.
Aglaia sp. 1: Pannell in Tree Fl. Malaya 4 (1989) 227.

Small tree up to 12 m. Bole up to 50 cm in circumference. Bark smooth, brownish-grey, lenticellate. Sapwood pale pink or white; latex white. *Twigs* stout, with a few white or reddish-brown stellate hairs. *Leaves* imparipinnate, up to 130 cm long and 100 cm wide; petiole up to 35 cm, petiole, rachis and petiolules with hairs like the twigs. *Leaflets* 7–9(–15), 16–48 by 6–12 cm, pale brown when dry, coriaceous, obovate or oblanceolate, recurved at the margin, acuminate or shortly caudate at apex, attenuate or occasionally rounded at base, upper surface rugulose, lower surface more markedly so and with a few stellate hairs on the midrib and veins; veins 7–20 on each side of the midrib, midrib and lateral veins subprominent with longitudinal wavy ridges on upper surface, prominent and more markedly ridged on lower surface; petiolules up to 25(–40) mm. *Inflorescence* up to 30 cm long and 15 cm wide; peduncle up to 14 cm, peduncle and branches with indumentum like the twigs. *Flowers* c. 3 cm long and 3 cm wide, subglobose; pedicels c. 1 mm, the pedicels and bracteoles densely covered with stellate scales. *Calyx* with few to numerous stellate scales. *Petals* 3. *Staminal tube* shorter than the corolla, cup-shaped, the apical margin shallowly lobed; anthers 7–9, as long as the tube and just protruding beyond the aperture. *Infructescence* with up to 5 fruits, very stout, the peduncle and branches with indumentum like the twigs. *Fruits* 6–7 by 5–6 cm, ellipsoid or obovoid, red or orange-red, dehiscent, densely covered with compact

Fig. 32. *Aglaia erythrosperma* Pannell. Apical bud of seedling. Seedling grown from *Pannell 1175*, Pasoh For. Res., Negri Sembilan, Malaysia. Photograph C.M. Pannell, 1978.

reddish-brown stellate hairs on the outer surface. Pericarp 2–5 mm thick, thickest at the apex, with white latex. Locules 3, each containing 1 seed. *Seeds* 4.5 cm long, 1.5 cm wide and 1.8 cm thick, completely covered with a red aril.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo.

Habitat — Found in primary lowland and hill forest, secondary forest, riverine forest and swamps; on clay; 10–830 m altitude.

Note — *Aglaia rugulosa* is a small tree with stout twigs and very large leaves. It resembles *A. erythrosperma*, but is a smaller tree, the upper surface of the leaflets is less shiny when dry and both surfaces are markedly rugulose; the base of the leaflet is usually markedly attenuate. The fruits are ellipsoid or obovoid, whereas they are subglobose in *A. erythrosperma*.

6. Aglaia erythrosperma Pannell

Aglaia erythrosperma Pannell, Kew Bull., Add. Ser. 16 (1992) 76.
Aglaia sp. 2: Pannell in Tree Fl. Malaya 4 (1989) 228.

Tree up to 35 m. Bole up to 23 m, up to 150 cm in circumference, with small L-shaped buttresses outwards up to 70 cm. Outer bark pale pinkish-brown with reddish-brown and grey patches, lenticellate and with longitudinal cracks, flaking off in irregular scales up to 15 cm in diam.; inner bark pinkish-brown, red or green. Sapwood pink or pinkish-brown; with watery greenish-brown exudate. *Branches* ascending patent. Twigs very stout, densely covered with brown stellate scales. *Leaves* imparipinnate, up to 60 cm long and 40 cm wide; petiole up to 25 cm, petiole, rachis and petiolules with indumentum like that on the twigs. *Leaflets* 7–19, 11–24 by 7.5–12 cm, shiny dark green on upper surface, coriaceous, elliptical, slightly recurved at margin, shortly acuminate at apex, usually rounded, sometimes cuneate at the asymmetrical base, lower surface dull, with few to numerous pale brown scales like those on the twigs on the midrib and veins and sparse on the surface in between; veins 7–13 on each side of the midrib, midrib and lateral veins raised and longitudinally ridged and wavy on lower surface; petiolules up to 15(–30) mm on lateral leaflets. *Inflorescence* up to 20 cm long; peduncle, branches and pedicels densely covered with stellate scales. *Flowers* c. 4.5 mm long and 3.5 mm wide; pedicels c. 1 mm. *Calyx* densely covered with stellate scales on the outer surface. *Petals* 3, with few to densely covered with stellate scales on the outside. *Staminal tube* shorter than the corolla, cup-shaped; anthers 6(–8), about 2/3 the length of the tube, narrowly ovoid, curved with the tube and just protruding beyond the aperture, with simple hairs on the inner surface of the tube and on the anthers. *Infructescence* up to 25 cm long with few fruits. *Fruits* up to 10 cm in diam., bright orange or red, densely covered with reddish-brown stellate hairs on the outside, subglobose, dehiscing into 3; pericarp up to 1.5 cm thick, inner pericarp white, innermost layer in each locule a detachable membrane surrounding the seed. Locules 3, each containing 1 seed. *Seeds* up to 5 cm long, 3.5 cm wide and 2 cm thick, completely surrounded with a bright shiny orange-red (? or sometimes yellow) aril, which is easily detached from the rest of the seed; testa shiny chestnut brown. — **Fig. 30a, b, 32.**

Fig. 33. *Aglaia spectabilis* (Miq.) Jain & Bennet. a. Leaf; b. inflorescence; c. half flower; d. fruits; e. seeds; f. stellate hair (a, f: *Putz FRI 23647*; b, c: *Wray 2107*; d, dehisced fruit: *Ridley 5027*, closed fruit and seeds: *Pennington 8055*). Drawing R. Wise.

Distribution — Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo.

Habitat — Found in evergreen forest, primary forest and kerangas; on granitic sand, sand, clay; 5–1300 m altitude.

Uses — Wood may provide good timber.

Note — *Aglaia erythrosperma* is a tall, sometimes emergent, tree with very stout twigs. It resembles *A. spectabilis*, but the leaflets are more coriaceous and are recurved at the margin and the midrib and lateral veins are raised and longitudinally ridged and wavy on the lower surface of the leaflets. The upper surface of the leaflets is dark shiny green, the lower surface is dull and has tiny stellate scales. The fruit is the size of a cricket ball and dehisces into three, revealing one bright orange-red arillate seed in each locule. The seeds contrast with the white of the inner pericarp and its brick red outer surface. The seeds are swallowed whole by Black Hornbills [Pannell & Koziol, Phil. Trans. Roy. Soc. B 316 (1987) 303–333].

7. **Aglaia spectabilis** (Miq.) Jain & Bennet

Aglaia spectabilis (Miq.) Jain & Bennet, Ind. J. For. 9 (1987) 271; Pannell, Kew Bull., Add. Ser. 16 (1992) 79, f. 13. — *Amoora spectabilis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 37; Hiern in Hook. f., Fl. Brit. India 1 (1875) 561, p.p.

Amoora ridleyi King, J. As. Soc. Beng. 64, ii (1895) 56; Ridley, Fl. Malay Penins. 1 (1922) 398. — *Aglaia ridleyi* (King) Pannell, Mal. For. 45 (1982) 455; in Tree Fl. Malaya 4 (1989) 223.

Amoora wallichii King, J. As. Soc. Beng. 64, ii (1895) 56.

Tree up to 40 m, rarely flowering at 8 m; bole up to 18 m, up to 150 cm in diam., with plank buttresses up to 200 cm high and up to 370 cm out. Bark greyish-white, pale yellowish-brown or brown, flaking in squarish scales up to 30 cm across, sometimes with large orange lenticels up to 3 mm in diam.; inner bark pink, reddish-orange or brown; sapwood pale brown, pink, white or magenta; latex white. Branches ascending. *Twigs* stout, sometimes more than 1 cm in diam., densely covered with reddish-brown or pale brown stellate hairs or scales, or peltate scales which have a fimbriate margin, with white latex. *Leaves* imparipinnate in dense spirals, the leaf bases almost overlapping, 50–135 cm long, 28–70 cm wide; petiole 14–25 cm, flattened on the adaxial side, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* (3–)11–21, 8–40 by 2.5–12.5 (–17) cm, coriaceous, acuminate at apex, rounded at the asymmetrical base, upper surface rugulose and sometimes pitted, lower surface pitted, with few to densely covered with pale brown or reddish-brown stellate hairs and scales on the midrib and a few on or occasionally densely covering the lateral veins and surface of the lamina, sometimes with a few darker peltate scales which have a fimbriate margin scattered on the rest of that surface; veins 9–19 on each side of the midrib, reticulation subprominent on lower surface; petiolules 8–20 mm. *Inflorescence* up to 50 cm long and 30 cm wide; peduncle up to 18 cm, peduncle, rachis and branches stout, with indumentum like the twigs. Male *flowers* 2–5 mm long and 2–3 mm wide; female flowers up to 7 mm long and up to 6 mm wide; pedicels up to 3 mm, with stellate hairs like those on the twigs. *Calyx* usually densely covered with stellate hairs on the outside. *Petals* 3, without or with numerous scales on the outside. *Staminal tube* slightly shorter than the corolla, cup-shaped; anthers (5 or)

6(–10), with about 1/4 of their length protruding beyond the aperture, sometimes with a few simple or forked hairs. *Infructescence* up to 13 cm long. *Fruits* 6–9 cm long and 5.5–9 cm wide, subglobose or obovoid, brown, red or yellow, densely covered with reddish-brown or pale yellowish-brown stellate hairs; pericarp up to 1 cm thick, with white latex, shiny reddish-brown inside. Locules 3 (or 4), each containing 0 or 1 seed. *Seeds* with aril 3.5–5 cm long and 2–2.7 cm wide, 1.5–2.2 cm thick; the aril entire, 2–4 mm thick, with a red, orange-red, yellow or white skin. — **Fig. 33.**

Distribution — India, Sikkim, Burma, Laos, Cambodia, Vietnam, China, Thailand, Solomon Islands, Santa Cruz Islands, Australia (Cape York Peninsula); *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines, Celebes, Lesser Sunda Islands (Sumba), New Guinea, New Britain.

Habitat — Found in secondary forest, riverine forest, primary forest, alluvial flats, coastal swamp and along the seashore; on sandy clay, sand, loam, sandstone, alluvial, coral; from sealevel up to 650 m altitude; scattered to common. This widespread species with its large dehiscent fruits may be dispersed by fruit pigeons, see Pannell & Kozioł, Phil. Trans. Roy. Soc. B 316 (1987) 303–333.

Uses — The timber is used for furniture and decorative work to the east of the Bay of Bengal and the seeds are said to yield a brown oil in Tonkin [Burkill, Dict. Econ. Prod. Malay Peninsula (1935) 137, under *Amoora gigantea* Pierre and *Amoora wallichii*].

Notes — 1. Causes dermatitis when milled (*Womersley NGF 9064*). See Henty [Bot. Bull. Lae 12 (1980) 98–103] for notes on this property in other species in Papua New Guinea.

2. In Peninsular Malaysia, the upper surface of the leaflets of *Aglaia spectabilis* is rugulose and pitted; in other parts of the range, the leaflet surfaces are often smooth and the upper surface slightly shiny. The raised reticulation and minute pitting give the leaflet undersurface a characteristic appearance. Numerous or sparse, tiny pale yellow stellate scales can always be found under magnification on the lower leaflet surface. The presence of the scales is a useful character for identifying sterile specimens and, in particular, distinguishes this species from *A. lawii* in Australasia, where the leaflet number in *A. spectabilis* is lower than in the west and overlaps with the number of leaflets found in *A. lawii*.

8. **Aglaia multinervis** Pannell

Aglaia multinervis Pannell, Kew Bull., Add. Ser. 16 (1992) 84.
Amoora lanceolata Hiern in Hook. f., Fl. Brit. India 1 (1875) 560; King, J. As. Soc. Beng. 64, ii (1895) 55; Ridley, Fl. Malay Penins. 1 (1922) 399, non *Aglaia lanceolata* Merr. (1910) (= *Aglaia rimosa*).
Aglaia sp. 3: Pannell in Tree Fl. Malaya 4 (1989) 228.

Tree up to 35 m. Bole up to 225 cm in circumference. Bark smooth, pale brown, reddish-brown or pinkish-grey with numerous reddish-brown lenticels and with deciduous scales which expose reddish-brown patches underneath; inner bark green or red; sapwood pale brown, pale pink, pale yellow or reddish-brown; latex white. *Twigs* stout,

densely covered with peltate scales which have a dark reddish-brown centre and pale fimbriate margin, sometimes with reddish-brown stellate hairs interspersed near the apex. *Leaves* imparipinnate, up to 40 cm long and 20 cm wide; petiole up to 10 cm, petiole, rachis and petiolules with a few stellate hairs. *Leaflets* 15–25, 6–15 by 1–3.5 cm, coriaceous, lanceolate, acuminate at apex, rounded or subcuneate at the asymmetrical base, lower surface rugulose, with few to densely covered with peltate scales on the midrib and scattered peltate or stellate scales elsewhere; veins 20–50 on each side of the midrib, longitudinally wrinkled and lateral veins hardly prominent on lower surface; reticulation sometimes visible; petiolules up to 10 mm. *Inflorescence* c. 20 cm long and 10 cm wide; peduncle up to 6 cm, peduncle, rachis, branches and pedicels with indumentum like the twigs. *Flowers* up to 3 mm long and 2.5 mm wide; pedicel up to 0.5 mm. *Calyx* densely covered with stellate scales on the outside. *Petals* 3, densely covered with stellate scales on the outside. *Staminal tube* shorter than the petals, subglobose, the aperture shallowly divided into c. 6 acute lobes; anthers 6, as long as or longer than the tube, narrowly ellipsoid, with a few simple hairs, inserted near the base of the tube and just protruding beyond the aperture. *Infructescence* with few fruits which ripen at different times; peduncle up to 6 cm, with surface and indumentum like the twigs. *Fruits* up to 6 cm long and 5 cm wide, brown, bright red or yellow, subglobose or obovoid with a small beak, densely covered with minute reddish-brown stellate hairs, dehiscent. Locules 3, each containing one *seed*.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Borneo.

Habitat — In forest, often on hillsides; up to 400 m altitude.

9. **Aglaia lepidopetala** Harms

Aglaia lepidopetala Harms, Bot. Jahrb. 72 (1942) 177; Pannell, Kew Bull., Add. Ser. 16 (1992) 86.

Small tree up to 5 m, bole up to 3 m, 2 cm in diam. *Twigs* sometimes with few, numerous or densely covered with compact reddish-brown stellate hairs (some of which have clumps of arms around a central rachis) and/or pale brown peltate scales which have a fimbriate margin. *Leaves* imparipinnate, 60–105 cm long; petiole 18–40 cm, with numerous scales like those on the twigs. *Leaflets* (7–)9–17, 7.5–26 cm by 3–7 cm, cuneate at the base, acuminate at the apex, pale brown when dry, the midrib below with few pale scales and reddish-brown hairs like those on the twigs and with scattered to numerous inconspicuous, pale brown stellate and peltate scales on the rest of the lower surface, leaflet surfaces matt, reticulation visible on the lower surface; veins 9–16 on each side of the midrib, with shorter lateral veins in between; petiolule 5–10 mm. *Inflorescence* 13–19 cm long, 4–8 cm wide, with one or two orders of branches only; peduncle 1.5–2.5 cm, peduncle, rachis and branches with numerous to densely covered with hairs and scales like those on the twigs. *Flower* 3.5–5.5 mm long, 3.5–6 mm wide; pedicel c. 2 mm, densely covered with stellate hairs or scales. *Calyx* densely covered with stellate hairs or scales on the outside. *Corolla* tube 4.5 mm long, 4–4.5 mm wide, divided almost to the base into 3 subrotund to broadly ovate lobes which are den-

sely covered with brown stellate scales on the outside. *Staminal tube* 2.5–4 mm long, 2–3.5 mm wide, the aperture 1–1.5 mm across, entire or shallowly lobed; anthers 9 or 10, inserted near the base of the tube, included or just protruding. *Infructescence* up to 9 cm long and 6 cm wide; peduncle 0.5–1 cm long, the peduncle, rachis and branches with numerous hairs and scales like those on the twigs. *Fruits* 1–9, 3–3.2(–4) cm long, 2.9–3 cm in diam., obovoid, dehiscent, orange or reddish-brown, densely covered with reddish-brown peltate scales which have a fimbriate margin and with numerous compound stellate hairs interspersed; the pericarp thin and moulded around the seeds when dry, dehiscing into three when ripe, white inside. Locules 3, each containing 0 or 1 seed. *Seeds* 2, 1–3.1 cm long, 1–1.8 cm wide, c. 1.6 cm through, almost or completely covered with a red aril c. 1 mm thick.

Distribution — *Malesia:* New Guinea.

Habitat — Found in primary forest, fresh water swamp forest, secondary forest and along roads; mainly in understorey; on volcanic clay, sandy clay, loamy clay; up to 1050 m altitude; rare.

Note — *Aglaia lepidopetala* is separated from *A. macrocarpa* by its compound stellate hairs (*A. macrocarpa* has no stellate hairs), the small size of the tree, smaller fruit and smooth lower leaflet surface. The fruits are smaller than in most species in section *Amoora*, except for *A. meridionalis* Pannell (endemic to Cape York Peninsula in Australia), ?*A. australiensis* Pannell (also endemic to Cape York Peninsula), *A. lawii* and *A. teysmanniana*.

10. Aglaia densitricha Pannell

Aglaia densitricha Pannell, Kew Bull., Add. Ser. 16 (1992) 90.

Tree c. 5 m, with a narrow bole. *Twigs* c. 1.5 cm in diam., densely covered with pale reddish-brown stellate hairs which have arms of different lengths. *Leaves* imparipinnate, c. 115 cm long and 60 cm wide; petiole c. 48 cm, petiole, rachis and petiolules densely covered with hairs like those on the twigs. *Leaflets* 11–13, 23–30 by 8–10 cm, oblong or ovate, the apex acuminate, rounded at the slightly asymmetrical base, with hairs like those on the twigs densely packed on the midrib and numerous on the rest of the lower surface; veins c. 18 on each side of the midrib; petiolules c. 15 mm. Male *inflorescence* 23–36 cm long, 18–24 cm wide; peduncle 3–10 cm; peduncle, rachis and branches densely covered with hairs like those on the twigs. Male *flowers* c. 4.5 mm long and 3 mm wide; pedicels 2–3 mm, the pedicels and calyx densely covered with hairs like those on the twigs. *Corolla* c. 4.5 mm long and 3–4 mm wide, divided up to nearly half way into 3 subrotund lobes. *Staminal tube* c. 4 mm long and 3 mm wide, obovoid, the aperture c. 1 mm in diam. with the margin shallowly lobed; anthers 6, inserted about 1/3 of the way up the tube and included. *Ovary* with ?3 locules. *Female flowers* and *fruits* not seen.

Distribution — *Malesia:* known only from the type locality in Trengganu, Peninsular Malaysia.

Note — *Aglaia densitricha* differs from *A. rubiginosa* in having numerous pale reddish-brown stellate hairs on the lower surface of the leaflets, whereas the lower surface of the leaflets of *A. rubiginosa* is densely covered with dark reddish-brown scales. *Aglaia densitricha* bears some resemblance to *A. rugulosa*, but lacks the rugulose leaflet surfaces and attenuate leaflet base.

11. Aglaia rubiginosa (Hiern) Pannell

Aglaia rubiginosa (Hiern) Pannell, Mal. For. 45 (1982) 455; in Tree Fl. Malaya 4 (1989) 225; Kew Bull., Add. Ser. 16 (1992) 92, f. 18. — *Amoora rubiginosa* Hiern in Hook. f., Fl. Brit. India 1 (1875) 561; King, J. As. Soc. Beng. 64, ii (1895) 54; Ridley, Fl. Malay Penins. 1 (1922) 398; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131, 198, pl. 36.
Aglaia ignea Valeton ex K. Heyne, Nutt. Pl. Ned.-Indië, ed. 1, 3 (1917) 59.

Large tree up to 35 m, sometimes with buttresses upwards up to 1 m, with an open crown formed by a few ascending branches terminating in up to 40 subcrowns. Bark pale pinkish-brown or greyish-brown, flaking in squarish or long narrow scales 2–3 cm wide; inner bark pale pinkish-brown; sapwood yellowish-brown, pale yellow or red; latex white. *Twigs* stout dark brown, with large leaf scars, densely covered with reddish-brown or dark brown stellate hairs. *Leaves* imparipinnate, up to 80 cm long and 50 cm wide; petiole up to 20 cm, petiole, rachis and petiolules with bark and indumentum like the twigs. *Leaflets* 15–21, 5–25 by 2–7 cm, dark shiny green above, coriaceous, lanceolate or ovate, acuminate at apex, rounded or cordate at the asymmetrical base, upper surface pitted, lower surface densely covered with reddish-brown stellate scales which have a darker, depressed centre or peltate scales which have a fimbriate margin, midrib and veins with similar but fewer scales; veins 11–24 on each side of the midrib, midrib and lateral veins prominent and with longitudinal wavy ridges on lower surface; petiolules up to 10(–20) mm. *Inflorescence* up to 70 cm long and 70 cm wide; peduncle up to 20 cm, peduncle, rachis and branches stout, flattened, longitudinally wrinkled, indumentum like the twigs. *Flowers* up to 9 mm long and 5 mm wide; pedicels up to 4 mm, with indumentum like the twigs. *Calyx* with indumentum like the twigs. *Petals* 3, glabrous. *Staminal tube* ellipsoid, the aperture up to 1.5 mm in diam. and shallowly 3-lobed; anthers 6, about 3/4 length of the tube, narrowly ovoid, usually included but sometimes just protruding through the aperture. *Infructescence* c. 20 cm long. *Fruits* c. 6 cm long and 5 cm wide, ellipsoid or obovoid, red; pericarp thick, with indumentum like the twigs. Locules 3, each containing 1 seed. *Seeds* with a complete red aril; testa brown; cotyledons pale yellow. — **Fig. 34.**

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Borneo.

Habitat — Found in freshwater peat swamp forest, dry heath forest, kerangas, and less frequently in primary lowland and hill forest, secondary forest and along roadsides; also on granitic sand; 2–300 m altitude; common.

Note — *Aglaia rubiginosa* is a conspicuous emergent tree in swamp forest. It has few ascending branches terminating in clumps of large pinnate leaves which form up to 40 subcrowns. The flower is among the largest found in *Aglaia*, the calyx is cup-shaped and only shallowly 3-lobed.

Fig. 34. *Aglaia rubiginosa* (Hiern) Pannell. Distinctive crown with nearly 40 subcrowns formed by discrete, dense spirals of large pinnate leaves at the end of branches. Port Klang, Selangor, Malaysia. Photograph C.M. Pannell, 1979.

12. **Aglaia penningtoniana** Pannell

Aglaia penningtoniana Pannell, Kew Bull., Add. Ser. 16 (1992) 94, f. 19.

Tree up to 45 m. Bole up to 20 m, diam. up to 150 cm, with buttresses upwards to 3 m and outwards to 2 m. Bark scaly, brown or pale greyish-brown; inner bark pinkish-brown. Sapwood hard, yellowish-brown or reddish-brown; latex white, copious, sticky. *Twigs* up to 2 cm in diam. at apex, densely covered with reddish-brown hairs which have a central rachis up to 1 cm long and 1 mm wide and numerous whorls of arms radiating from it, hairs sometimes deciduous and exposing numerous pale brown or dark reddish-brown stellate hairs and scales; latex white and copious. *Leaves* in dense terminal spirals, imparipinnate, 35–100 cm long, 36–70 cm wide; petiole 15–35 cm; petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 11–13, 8–40 by 4.5–12 cm, shining dark green on upper surface, glossy pale green on lower surface, coriaceous, asymmetrical and curved, rounded or slightly cuneate at the asymmetrical base, rounded at the apex, the upper and lower surfaces of the leaflets rugulose, with few to numerous white stellate scales on the midrib and occasionally on the rest of the lower surface; veins 13–21 on each side of the midrib, the lateral veins subprominent on the lower surface; petiolules 5–10 mm. *Inflorescence* c. 22 cm long and 7 cm wide; peduncle up to 8 cm, peduncle, rachis, branches and pedicels with hairs and scales like those on the twigs, deciduous, leaving densely packed pale brown stellate scales. *Flowers* c. 8 mm long and 6.5 mm wide; pedicels up to 3 mm. *Calyx* densely covered with pale brown stellate scales on the outer surface. *Petals* 3. *Staminal tube* obovoid, the margin of the aperture slightly lobed, anthers 17–21, 1/3–2/3 the length of the staminal tube packed together and alternating in two rows, all included. *Fruits* c. 8 cm long and 7 cm wide, dark orange-brown, subglobose or obovoid, dehiscent, the outer surface rough but with few or no stellate hairs or scales; pericarp up to 1.5 cm thick, with copious white latex. Locule 1, containing 1 large *seed*, c. 7 cm long, 4.5 cm wide and 4.5 cm thick; aril up to 4 mm thick, hard and with a dark red outer skin. Cotyledons transverse, slightly unequal. Shoot axis up to 7 mm long and 5 mm wide, plumule densely covered with orange-brown stellate hairs.

Distribution — *Malesia:* Papua New Guinea only.

Habitat — Low and montane rain forest; 30–1550 m altitude.

Notes — 1. *Aglaia penningtoniana* resembles *A. rugulosa*, but the twigs, petiole, rachis, and the peduncle and branches of the inflorescence and infructescence of *A. penningtoniana* have hairs which resemble those found in *A. grandis*. The central rachis of the hair is longer than in *A. grandis*, up to 1 cm long, and the whorls or arms radiating from it are more numerous; these hairs may be densely packed, but they are sometimes deciduous.

2. The lower surface of the leaflets in this species is either densely covered with reddish-brown stellate hairs (as in the holotype) or almost without hairs; in the former, the indumentum is sometimes deciduous on part of the leaflet, but it is not clear whether the lower surface of the leaflets of the latter would also have been densely covered with hairs when young and whether these were deciduous before maturity.

13. Aglaia lawii (Wight) Saldanha ex Ramamoorthy

Aglaia lawii (Wight) Saldanha ex Ramamoorthy in Saldanha & Nicolson, Fl. Hassan Distr. (1976) 392, pl. 76; Pannell, Kew Bull., Add. Ser. 16 (1992) 97. — *Nimmonia lawii* Wight, Calc. J. Nat. Hist. 7 (1847) 13, nom. nov. pro *Epicharis exarillata* Nimmo in J. Graham, Cat. Pl. Bombay (1839) 31, non Wight & Arn., Prodr. (1834) 120.

Amoora korthalsii Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 36. — *Aglaia korthalsii* (Miq.) Pellegr. in Fl. Indo-Chine 1 (1911) 771, non Miq. (1868).

Aglaia submonophylla Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 40.

Aglaia oligocarpa Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 45; Pannell in Tree Fl. Malaya 4 (1989) 221.

Aglaia littoralis Zipp. ex Miq., l.c.

Milnea sp.: Kurz, Rep. Veg. Andaman Isl. (1870) 33.

Amoora lactescens Kurz, J. As. Soc. Beng. 44, ii (1875) 20, syn. nov.

Aglaia andamanica Hiern in Hook. f., Fl. Brit. India 1 (1875) 555; King, J. As. Soc. Beng. 64, ii (1895) 79.

Lansium pedicellatum Hiern in Hook. f., Fl. Brit. India 1 (1875) 558, non Kosterm., Reinwardtia 7 (1965) 31, t. 11 (= *Lansium domesticum* Correa). — *Aglaia pedicellata* (Hiern) Kosterm., Reinwardtia 7 (1966) 226, 264. — *Aglaia stipitata* Li & Chen, Acta Phytotax. Sin. 22 (1984) 495.

Amoora maingayi Hiern in Hook. f., Fl. Brit. India 1 (1875) 562; Ridley, Fl. Malay Penins. 1 (1922) 400. — *Aglaia maingayi* (Hiern) King, J. As. Soc. Beng. 64, ii (1895) 79.

Amoora dysoxyloides Kurz, J. As. Soc. Beng. 44, ii (1876) 200.

Aglaia turczaninowii C.DC. in DC., Monogr. Phan. 1 (1878) 623.

Aglaia beccarii C.DC., Bull. Herb. Boiss. 2 (1894) 579.

Aglaia eusideroxylon Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 128; Koord., Atlas 1 (1913) t. 97; Backer & Bakh. f., Fl. Java 2 (1965) 127.

Amoora lepidota Merr., Philipp. Govt. Lab. Bur. Bull. 17 (1904) 23.

Aglaia brachybotrys Merr., Philipp. J. Sc., Bot. 7 (1912) 274.

Aglaia cagayanensis Merr., Philipp. J. Sc., Bot. 7 (1912) 275.

Aglaia sclerocarpa C.DC., Meded. Rijksherb. Leiden 22 (1914) 9.

Amoora curtispica L.S. Gibbs, J. Linn. Soc., Bot. 42 (1914) 63.

Aglaia alternifoliola Merr., Philipp. J. Sc., Bot. 9 (1915) 532.

Aglaia grandifoliola Merr., Philipp. J. Sc., Bot. 13 (1918) 293.

[*Aglaia sibuyanensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 376, pro syn.; Elmer, Leafl. Philipp. Bot. 9 (1937) 3308, nom. nud.]

Aglaia trimera Merr., Univ. Calif. Publ. Bot. 15 (1929) 128.

Aglaia racemosa Ridley, Kew Bull. (1930) 367.

Tree up to 30 m, sometimes flowering as an unbranched treelet c. 1.6 m high. Bole up to 75 cm in diam., fluted and with concave or tall narrow buttresses, upwards up to 1.8 m, outwards up to 1 m. Bark reddish-brown, orange brown, yellowish-brown or pale pinkish-brown, rough and flaking in large thin irregular scales, sometimes with large round orange lenticels, or bark grey or greenish-brown and smooth; inner bark green, cambium white, sapwood pale orange, orange-brown or yellowish-brown, sometimes turning magenta pink on exposure to air; latex white. *Twigs* usually slender, sometimes up to 9 mm across, densely covered with pale brown or pale orange brown, usually peltate scales which have an irregular or fimbriate margin and may have a dark brownish-black central spot, sometimes densely covered with stellate scales and sometimes with stellate hairs interspersed. *Leaves* imparipinnate, 7–66 cm long and 5–60 cm wide; petiole 1.5–16 cm, petiole, rachis and petiolules with a few or densely covered with scales like those on the twigs, in Borneo the rachis sometimes ridged or with nar-

row foliolate wings up to 3 mm wide. *Leaflets* (1) 2–7(–11), 4–30 by 1.5–11.5 cm, often orange-brown or whitish-green when dry, especially the veins, sometimes subcoriaceous, acuminate or acuminate-caudate at apex, usually broadly cuneate but occasionally rounded, attenuate or (sometimes in Borneo) cordate at the asymmetrical base, sometimes rounded on the distal side and cuneate on the proximal side of the petiolule, often with numerous pits on the upper and lower surfaces, without hairs or scales or with occasional or numerous scales like those on the twigs on the lower surface; veins 5–21 on each side of the midrib, reticulation barely visible or subprominent on the lower surface; sometimes (but not in Peninsular Malaysia) with a depression in the axil between the lateral vein and the midrib which is surrounded by a dense tuft of stellate hairs which have long arms or simple hairs; sessile or with petiolules up to 20 mm. *Inflorescences* in the axils of c. 5 leaves near the apex of the shoot, in Borneo sometimes ramiflorous, 2.5–22 cm long and 1.5–20 cm wide; sessile or with a peduncle up to 10.5 cm long, peduncle, rachis and branches with numerous or densely covered with scales or hairs like those on the twigs. *Flowers* 1.5–4.5 mm long, 1.5–5 mm wide; pedicel 0.5–5 mm, the pedicels and calyx with few to densely covered with pale brown or orange peltate scales which have a fimbriate margin or occasionally with stellate hairs. *Calyx* divided into 3 or 4(–6) obtuse lobes. *Corolla* a short tube connate with the base of the staminal tube, divided into 3 or 4(–6) subrotund lobes, sometimes with a few scales like those on the twigs on the outside. *Staminal tube* shorter than the corolla, either obovoid with the aperture entire and 0.3–0.5 mm in diam. or cup-shaped with the apical margin incurved and shallowly lobed and 0.6–1.5 mm in diam.; anthers (5) 6–10 (11), ovoid, 1/3–3/4 the length of the tube, inserted in the uppermost 1/3–1/2 of the tube, included or just protruding through the aperture, sometimes with a few simple hairs on the anthers and the inside of the staminal tube. *Infructescence* 3.5–15 cm long with 1–20 fruits which ripen at different times; sessile or with a peduncle up to 5.5 cm with surface and indumentum like the inflorescence. *Fruits* 1.7–2.8(–6) cm long, 1.2–2.3(–3.5) cm in diam., subglobose, obovoid, ellipsoid or pear-shaped, sometimes with a small beak, asymmetrical if a seed does not develop in each locule, dehiscent, fruit-stalk 1.5–15 mm; pericarp usually c. 2.5 mm thick but sometimes in Borneo thinner so that it is moulded around the seeds in the dried fruit, outer pericarp pink or sometimes carmine red or yellow, densely covered with scales like those on the infructescence branches, inner pericarp white; locules (2 or) 3 (or 4), each containing 0 or 1 arillate *seed*; aril 1–3.5 mm thick, the edges nearly meeting or meeting and overlapping on the antiraphe side, easily peeled off the testa, the outer skin red or white, the flesh soft, white and oily; seed with aril removed c. 14 mm long, 7 mm wide and 6 mm thick; testa shiny dark brown.

Distribution — India, Bhutan, Burma, Andaman Islands, Great Cocos Island, Laos, Vietnam, China, Taiwan, Thailand, Solomon Islands; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, Lesser Sunda Islands, Moluccas, New Guinea, New Britain.

Habitat — Seashore, primary lowland and hill forest up to 1650 m, in wet evergreen forest, semi-evergreen forest, deciduous forest, peat swamp forest, riverine forest; up

to 500 m in secondary forest; on limestone, sandstone, granite, clay, sandy loam and alluvial river soil; rare to common.

Uses — Leaves are applied for headache (Mindanao); wood is used for construction (Palawan).

Notes — 1. *Aglaia lawii* is one of the most widespread, variable and ecologically versatile species of the genus. In the Philippines and Irian Jaya, the habitats in which this species occurs include the seashore and in Borneo it is known from coastal forests, peat swamp, stream-side, alluvial river soil, secondary forest and forest on limestone and sandstone. *Aglaia lawii* and its close relative, *A. teysmanniana*, can usually be recognized by their small (c. 2 cm diam. in most parts of the range), dehiscent, usually pink fruits and the red-skinned arillate seeds. The fruits of *A. lawii* are, however, sometimes much larger in China, Java and New Guinea (see below).

2. The variation patterns in *A. lawii* are partly geographical: for example the flower may be larger and the staminal tube may have a smaller aperture in India and China; some specimens from India, Borneo and the Philippines have stellate hairs as well as peltate scales; in Borneo the petiole and rachis are frequently winged and in both drier and littoral localities the scales may be more numerous on the lower surface of the leaflets, this being especially marked in some specimens from China, Taiwan and Java. In India, China and the Philippines, depressions surrounded by simple or stellate hairs (domatia), are often found in the axils of the lateral veins and midrib on the lower surface of the leaflets.

Variation also occurs in leaflet number and in the size of flowering and fruiting individuals. In Borneo, this species may flower as a small, unbranched treelet with simple leaves. Simple leaves are also found, together with compound leaves, on taller, branched individuals of this species. The small treelets may occur in the same site as the tall trees and they appear in the field to belong to different, clearly distinguishable species (e.g. Gunong Palung, Kalimantan; M.M.J. van Balgooy, pers. comm.). Attempts to recognize separate species based on variation in the structure and density of the indumentum, the flower size and structure and the fruit size and shape, failed because, although the variation in these characters is considerable, none of them is sufficiently correlated with any other to provide a means of delimiting separate taxa.

The most variable character is the structure and density of the indumentum and the frequency of pits on the leaflet surfaces. Near the equator, the leaves are almost without pits and scales, but in areas with more seasonal climates, the upper and lower leaflet surfaces often have numerous pits and there are numerous scales on the lower leaflet surface.

3. With the exception of the largest of the fruit variants in *A. lawii*, the fruits of this species, along with *A. teysmanniana*, are the smallest among the dehiscent species of *Aglaia* and the pericarp of the ripe fruit is nearly always pink. The fruit of *A. lawii* varies in shape from subglobose to pear-shaped. With few exceptions, the seed has an entire red-skinned aril. Biochemical analyses of seeds collected in Peninsular Malaysia have shown that the aril of *A. lawii* is lipid-rich (61% dry weight) while observations of vertebrates feeding on the seeds in Peninsular Malaysia have shown that seeds are swal-

lowed whole and are probably dispersed by birds ranging in size from bulbuls to magpies and hornbills [Pannell & Kozioł, Phil. Trans. Roy. Soc. B 316 (1987) 303–333]. Some of these, especially hornbills, may occasionally disperse seeds over long distances. Such dispersal, by birds of different sizes and mobility may, in part, explain the frequency and wide distribution of this species.

4. *Aglaia teysmanniana* is maintained as a species distinct from *A. lawii* because its indumentum consists exclusively of stellate hairs which usually have long arms and may densely cover the lower leaflet surface, but the distinction between this species and *A. lawii* when the latter has stellate hairs in Borneo and the Philippines is sometimes not clear. In this treatment, any specimen which has some peltate scales is assigned to *A. lawii*. The fruit of *A. teysmanniana* is similar to *A. lawii* except for its indumentum of stellate hairs.

5. Examination of isotype material (M) of *Amoora lactescens* shows that this plant, listed as unplaced by Pannell [Kew Bull., Add. Ser. 16 (1992) 352], belongs here.

14. Aglaia teysmanniana (Miq.) Miq.

Aglaia teysmanniana (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 48; Pannell in Tree Fl. Malaya 4 (1989) 226; Kew Bull., Add. Ser. 16 (1992) 108. — *Amoora teysmanniana* Miq., Fl. Ind. Bat., Suppl. 1 (1861) 196, 503.

[*Milnea montana* Teijsm. & Binn., Cat. Hort. Bogor. (1866) 211, nom. nud., ? non Jack.]

Aglaia subgrisea Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 54.

Aglaia heptandra Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 132; Koord., Atlas 1 (1913) t. 157; Backer & Bakh. f., Fl. Java 2 (1965) 126.

Tree up to 15 m, with rounded crown. Bole up to 50 cm in circumference. Bark greyish-brown or pale brown with longitudinal cracks and lenticels; inner bark dark brown; sapwood pale yellowish-brown; latex white. *Twigs* slender, densely covered with pale yellowish-brown stellate hairs which have arms up to 1.5 mm long. *Leaves* imparipinnate, up to 60 cm long and 50 cm wide; petiole up to 9.5 cm long, petiole, rachis and petiolules densely covered with stellate hairs like those on the twigs. *Leaflets* (1–)5–9, 4.8–25 by 2–8.2 cm, acuminate or shortly caudate at apex, cuneate or rounded at the asymmetrical base, densely covered with pale yellow stellate hairs on the midrib and numerous on the rest of the lower surface where they are often deciduous; veins 9–21 on each side of the midrib, petiolules up to 10(–20) mm. *Inflorescence* up to 15 cm long and 15 cm wide; peduncle c. 10 mm, peduncle, rachis, branches and pedicels rather angular and longitudinally ridged with numerous pale yellowish-brown stellate scales or hairs with short arms. *Flowers* 1.5–2 mm in diam., subglobose; pedicels up to 2 mm. *Calyx* densely covered with scales like those on the branches on the outer surface, shallowly divided into 4 or 5 rounded lobes. *Petals* 3–5, glabrous, aestivation imbricate or quincuncial. *Staminal tube* shorter than the corolla, cup-shaped with the apical margin incurved; anthers (6) 7(–9), about half the length of the tube, ellipsoid, just protruding beyond the aperture. *Infructescence* with 1–4 fruits, up to 10 cm long and 6 cm wide; peduncle up to 6 cm, the peduncle, rachis, branches and fruit-stalks with longitudinal ridges and hairs like the twigs. *Fruits* 1–2.2 cm long, 1.3–2 cm wide, pink, sub-

globose, dehiscing loculicidally into 3, pericarp with shallow longitudinal wrinkles, and densely covered with pale brown stellate scales, c. 2 mm thick, white, turning pink on exposure to air, containing some latex; innermost layer of the pericarp in each locule a detachable membrane surrounding the seed; locules 3. *Seeds* 1–3, (0.7–)1.1–1.4 cm long, (0.4–)0.6–0.9 cm wide, obovoid; aril orange or red, the edges almost or quite meeting on the antiraphe side. — **Fig. 30d, e.**

Distribution — China, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, Moluccas, New Guinea.

Habitat — Found in evergreen forest, primary and secondary; on limestone, sandy soil, clay, loam; sealevel to 1670 m altitude; rare to common.

Uses — Firewood (Borneo, Keningau).

Notes — 1. *Aglaia teysmanniana* bears a superficial resemblance to *Dysoxylum grande* Hiern, but it is distinguished by its stellate hairs, whereas *Dysoxylum* has simple hairs.

2. The hairs are pale brown and may be sparse or numerous; in the latter case, the arms of adjacent hairs overlap to form a continuous indumentum on the lower surface of the leaflets. The fruit is small, pink and dehiscent with 1–3 seeds, the seeds have a complete aril which has an orange skin.

3. The stellate indumentum distinguishes *A. teysmanniana* from *A. lawii* (see note under that species).

Section Aglaia

Aglaia sect. *Aglaia*. — *Aglaia* sect. *Euaglaia* Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 298; ed. 2, 19b1 (1940) 144.
Aglaia sect. *Hearnia* (F. Muell.) Harms, op. cit. (1896) 298; op. cit. (1940) 146.
Aglaia sect. *Neoaglaia* Harms, op. cit. (1896) 300; op. cit. (1940) 146.
Aglaia sect. *Beddomea* (Hook. f.) Harms, op. cit. (1896) 300.
Aglaia sect. *Macroaglaia* Harms, op. cit. (1896) 300.

Calyx with 5 (or 6) obtuse or acute lobes. *Petals* 5 (or 6), aestivation usually quincuncial, imbricate when petals 6. *Anthers* 5(–10). *Ovary* with usually 1 or 2, rarely 3, or (in *A. costata*) ?5 or ?10 locules. *Fruit* indehiscent, sometimes with one or more longitudinal ridges along which the pericarp splits open under pressure. *Seed* with translucent, yellow, orange or white aril, with gelatinous flesh.

Note — In some species the leaves are almost without indumentum (e.g. *A. odorata, A. oligophylla, A. leptantha*), but the indumentum is usually more conspicuous with the hairs or scales larger and more dense than in most of the species in section *Amoora*.

15. Aglaia grandis Korth. ex Miq.

Aglaia grandis Korth. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 56; Pannell in Tree Fl. Malaya 4 (1989) 217; Kew Bull., Add. Ser. 16 (1992) 111, f. 23.
Aglaia lanuginosa King, J. As. Soc. Beng. 64, ii (1895) 71; Ridley, Fl. Malay Penins. 1 (1922) 407; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131.

Aglaia hemsleyi Koord., Minah. (1898) 383, 635 ('*helmsleyi*').
?*Aglaia bernardoi* Merr., Philipp. J. Sc., Bot. 9 (1914) 302.
Aglaia stellatotomentosa Merr., Philipp. J. Sc., Bot. 9 (1915) 535 ('*stellato-tomentosa*').
[*Aglaia perfulva* Elmer, Leafl. Philipp. Bot. 9 (1937) 3302, nom. nud.]

Tree up to 27 m, sometimes small and unbranched. Bole up to 17 m, up to 75 cm in circumference. Bark smooth, grey, with shallow longitudinal fissures; inner bark brown or dark brown; sapwood pinkish-brown, brown or yellow; latex white. *Twigs* stout, up to 2 cm in diam., with many leaf scars, densely covered with brown hairs which have a central rachis and 2–4 whorls of arms radiating from it; apical bud up to 2.5 cm in diam. *Leaves* in spirals towards the ends of the twigs where they are very close together and the expanded bases of the petioles overlap, imparipinnate, up to 135(–200) cm long and 80 cm wide; petiole up to 20 cm long, up to 2 cm across at the base, petiole, rachis and petiolules with indumentum like the twigs; latex white. *Leaflets* 11–21(–25), 8.5–58 by 4–18 cm, upper surface shiny, coriaceous, acuminate at apex, narrowed to a usually subcordate, asymmetrical base, sometimes cuneate, especially on the terminal leaflet, lower surface densely covered with pale brown hairs up to 1 mm long, like those on the twigs, with the surface visible between the hairs; veins 14–36 on each side of the midrib, reticulation visible on both surfaces; petiolules up to 20 mm. *Inflorescence* up to 30 cm long and 15 cm wide, the final branches up to 20 mm long and densely packed with sessile flowers; peduncle up to 7 cm, peduncle, rachis and branches clothed like the twigs. *Flowers* up to 2 mm in diam. *Calyx* with hairs on the outer surface like those on the twigs. *Petals* 5, c. 1.5 by 0.6 mm. *Staminal tube* c. 1 mm long, shorter than the corolla, subglobose with the aperture wide and deeply 5-lobed; anthers 5, ovoid, half to nearly as long as the tube and just protruding through the aperture. *Infructescence* up to 40 cm long and 24 cm wide, with c. 5 fruits. *Fruits* brown, up to 5 cm long and 4.5 cm in diam., obovoid, sometimes with a small beak, with a thick indumentum of hairs up to 4 mm long like those on the twigs, fruitstalks up to 2 cm.

Distribution — Vietnam, Thailand; *Malesia:* Peninsular Malaysia, Borneo, Philippines, Celebes.

Habitat — Primary forest, sometimes on ultrabasic rock and limestone; sealevel to 1700 m altitude.

Notes — 1. The hairs of *Aglaia grandis* have a central rachis from which radiate 2–4 whorls of arms. The arms of the hairs on the twigs and fruits are long and the indumentum is dense forming a continuous, pale brown woolly covering. The hairs also densely cover the lower surface of the leaflets, but the surface is visible between the hairs. There are as many as 36 lateral veins on each side of the midrib. The twigs, petiole, rachis and peduncle are terete.

2. A distinctive form of this species, which may merit recognition as a subspecies, occurs on ultrabasic rock in the Philippines. It has smaller leaflets which have a reddish-brown indumentum on the lower surface and recurved margin; it has not been formally described and named by the present author, because no distinguishing floral or fruit character has been found in the specimens examined.

16. Aglaia ramotricha Pannell

Aglaia ramotricha Pannell, Kew Bull., Add. Ser. 16 (1992) 115.

Tree 6–15(–20) m. Bole up to 20 cm in diam., with small buttresses upwards to 60 cm and outwards to 30 cm. Outer bark brown; inner bark pale brown or pink; sapwood yellow or brown. *Twigs* stout, 2–4 cm in diam., densely covered with compact reddish-brown stellate hairs or brown hairs which have a central rachis and 2–4 whorls of arms radiating from it. *Leaves* imparipinnate, up to 155 cm long and 100 cm wide; peduncle up to 46 cm, the base of the peduncle up to 2.5 cm across on the abaxial side and up to 1.5 cm across on the adaxial side, the adaxial side deeply channelled, peduncle, rachis and petiolules densely covered with hairs like those on the twigs or densely covered with pale brown stellate hairs or scales. *Leaflets* 15–21, 8.5–68 by 3–22 cm wide, broadly acuminate at apex, rounded or sometimes subcordate or cuneate at base, with hairs like those on the twigs numerous on the lower surface of the leaflets when young, with reddish-brown stellate hairs or pale brown or nearly white stellate hairs and scales numerous on the midrib and veins on the lower surface and few on the rest of that surface when mature; veins 16–32 on each side of the midrib, the reticulation subprominent on both surfaces; petiolules up to 1 cm. *Inflorescence* up to 32 cm long and 32 cm wide; peduncle up to 5.5 cm, peduncle, rachis and branches densely covered with hairs like those on the twigs or the distal branches densely covered with golden brown stellate hairs. *Flowers* 1.6–3.5 mm long, 1.6–2.5 mm wide, sessile and clumped around the distal branches of the sparsely branched inflorescence. *Calyx* with few pale brown stellate scales. *Corolla* 1.3–3 mm long, 1.4–2.5 mm wide, divided to half way or almost to the base into 5 broad ovate lobes. *Staminal tube* 1–2.5 mm long, 1.1–1.8 mm wide, aperture 0.4–0.6 mm in diam., entire; anthers 5, occupying the middle or upper part of the tube and either included in or just protruding through the aperture. *Infructescence* up to 45 cm long and 50 cm wide, peduncle 12–18 cm, peduncle, rachis and branches densely covered with hairs like those on the twigs and with some pale brown stellate hairs interspersed. *Fruits* reddish-yellow, c. 3.5 cm in diam., subglobose or ellipsoid, with numerous to densely packed compact reddish-brown hairs or pale brown stellate hairs, indehiscent; locules 2 or 3, each containing 1 seed. *Seeds* to 2 cm wide and 1.2 cm thick.

Distribution — *Malesia:* Borneo.

Habitat — Understorey tree in primary forest on limestone; 35–1600 m altitude.

Note — *Aglaia ramotricha* resembles *A. grandis* in its hairs which have a central rachis and several whorls of arms radiating from it, but it differs from the latter in having a much less dense indumentum on the lower surface of the leaflets and subprominent reticulation on both surfaces.

17. Aglaia pachyphylla Miq.

Aglaia pachyphylla Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 57; Pannell, Kew Bull., Add. Ser. 16 (1992) 117.

Aglaia barbatula Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 167; Koord., Atlas 1 (1913) t. 153; Backer & Bakh. f., Fl. Java 2 (1965) 126; Pannell in Tree Fl. Malaya 4 (1989) 213.

?*Aglaia clarkii* Merr., Philipp. Govt. Lab. Bur. Bull. 29 (1905) 21.
Aglaia megistocarpa Merr., Univ. Calif. Publ. Bot. 15 (1929) 130.

Tree up to 43 m, sometimes flowering at 1.8 m, with a few ascending branches which have terminal clusters of leaves forming a small, open crown. Bole up to 20 m, up to 65 cm in diam., sometimes with buttresses to 3 m high, to 1 m out and up to 22 cm thick. Outer bark brown, greyish-brown or greenish-grey, with large corky lenticels or with pits and regularly longitudinal fissures, the fissures narrow, deep and c. 15 cm long, the intervals flat and somewhat scaly; inner bark dark brown or pale yellowish-brown, thick, firm and finely fibrous, sapwood pinkish-brown, pale brown or pale yellow; heartwood brown; latex white, when present. *Twigs* stout, up to 2.5 cm in diam., with large prominent leaf scars and densely covered with reddish-brown stellate hairs or hairs which have a long central rachis and many arms. *Leaves* up to at least 135 cm long and 60 cm wide, imparipinnate, in spirals particularly towards the ends of the twigs where they are very close together, the petiole bases crowded together; petiole up to 30 cm, with a groove on the adaxial side, petiole, rachis and petiolules angular, with longitudinal channels and densely covered with hairs like those on the twigs; latex white. *Leaflets* 13–23, 10–52 by 3–11 cm, upper surface shiny, acuminate at apex, usually rounded and subcordate but sometimes cuneate at the asymmetrical base, upper surface with numerous minute pits, lower surface densely covered with pale reddish-brown hairs which have a central rachis and 2–4 whorls of arms radiating from it, the surface of the leaflet barely visible between the hairs or densely covered with pale or dark brown stellate hairs or scales which sometimes have scattered darker hairs in between, sometimes densely covering the upper surface in young leaves, sometimes deciduous on lower surface of old leaves; veins (15–)20–45 on each side of the midrib, reticulation subprominent or visible on both surfaces; petiolules up to 10(–25) mm. *Inflorescence* up to 45 cm long and 60 cm wide, flowers sessile on the final branches and often clumped together; peduncle up to 10 cm, peduncle, rachis, and branches angular, channelled and densely covered with hairs like those on the twigs. *Flowers* subglobose, up to 2 mm in diam., sessile. *Calyx* densely covered with pale brown stellate hairs on the outer surface. *Petals* 5. *Staminal tube* subglobose, thick and fleshy, deeply 5-lobed; anthers 5, as long as the tube, ovoid and curved with the tube, with tufts of white stellate hairs at the apex and at the base of each locule, those at the apex filling the aperture of the tube. *Infructescence* with 1–15 fruits, up to 20 cm long and 15 cm wide; the fruitstalks up to 15 mm. *Fruits* up to 8 cm in diameter, obovoid or subglobose, greyish-green when young, brown when mature, densely covered with hairs like those on the twigs, glabrescent; the pericarp 3–5 mm thick, with white latex. Locules 2(–4), each containing 1 or 2 seeds. *Seed* completely surrounded by a fleshy, translucent aril.

Distribution — Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes.

Habitat — Found in primary forest and secondary swamp forest, and along margins of forest; on limestone, clay and sandstone; sealevel to 1350 m altitude. Frequent along rivers to very common.

Uses — The wood is hard and said to be durable; it is used for planks and temporary construction.

Note — This species resembles *Aglaia grandis*, but it is usually a larger tree with an open crown like that of *A. rubiginosa*. The hairs are shorter than in *A. grandis* and cover the lower side of the leaflets so densely that the surface is not or barely visible. There are usually more lateral veins on each side of the midrib than in *A. grandis*. The twigs, petiole, rachis and peduncle are angular and deeply channelled. When the hairs are short, it is sometimes similar in appearance to *A. eximia*, but it may be distinguished by the shape of the leaflet, greater number of veins and the prominence of the reticulation on the dark, shiny upper surface. When the indumentum is dark, it may resemble *A. rubiginosa*, but the flowers are pentamerous in *A. pachyphylla* and trimerous in *A. rubiginosa*.

18. Aglaia eximia Miq.

Aglaia eximia Miq., Fl. Ind. Bat., Suppl. 1 (1861) 197, 506; Pannell in Tree Fl. Malaya 4 (1989) 215; Kew Bull., Add. Ser. 16 (1992) 121, f. 27. — *Aglaia argentea* Blume var. *eximia* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 55; King, J. As. Soc. Beng. 64, ii (1895) 70; Ridley, Fl. Malay Penins. 1 (1922) 405.

?*Aglaia ancolana* Miq., Fl. Ind. Bat., Suppl. 1 (1861) 506.

Aglaia argentea Blume var. *latifolia* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 55.

Aglaia argentea Blume var. *stellatipilosa* Adelb., Blumea 6 (1948) 321 ('*stellati-pilosa*').

Aglaia argentea auct. non Blume: Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131, et mult. auctt.

Tree up to 15 m, with a rounded crown. Bole up to 10 m. Outer bark smooth, greyish-brown with some lenticels in longitudinal rows; inner bark brown or pale brown; sapwood pale yellow or pale brown, sometimes tinged with pink; latex white. *Twigs* stout, densely covered with brown stellate scales. *Leaves* imparipinnate, at least up to 135 cm long and 50 cm wide; petiole up to 25 cm long, petiole, rachis and petiolules with scales like the twigs. *Leaflets* 11–21, 6–42(–58) by 2–11(–16) cm, acuminate at the apex, usually rounded at the asymmetrical subcordate base but the terminal leaflet usually cuneate, lower surface thickly covered with white and pale brown stellate scales, often with some brown stellate hairs interspersed; veins 10–22(–29) on each side of the midrib; petiolules up to 5 mm on lateral leaflets, up to 15(–50) mm on terminal leaflet. *Inflorescence* up to 40 cm long and 28 cm wide, peduncle up to 10 cm, peduncle, rachis and branches with surface and indumentum like the twigs. *Flowers* sessile, up to 2 mm in diam. *Calyx* densely covered with brown stellate hairs. *Petals* 5. *Staminal tube* sometimes shallowly cup-shaped with the rim incurved, usually ellipsoid with the aperture up to 0.5 mm in diam. and obscurely 5-lobed; anthers almost as long as the tube, ovoid, inserted near the bottom of the tube, usually included but sometimes protruding through the pore. *Infructescence* up to 32 cm long and 16 cm wide; peduncle up to 10 cm. *Fruits* up to 3 cm long, 2.2 cm wide, ellipsoid or subglobose, grey or brown; pericarp thin, densely covered with reddish-brown stellate scales or peltate scales which have a fimbriate margin on the outside, containing white latex; locules 1–3, each containing 1 seed. *Seed* with a thin aril; the aril white, pale yellow or pink.

Distribution — Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Java, Philippines, Celebes, Moluccas.

Habitat & Ecology — Found in primary forest, secondary forest, lowland and montane forest, sometimes on limestone; sealevel to 2000 m altitude; often common. Small black ants found inside hollow petioles in Sumatra.

Uses — Aril edible when taken in moderation.

Note — The lower surface of the leaflets is densely covered with white or pale brown stellate scales. In the density of the indumentum, *A. eximia* resembles *A. argentea*, but in the latter species the indumentum is of peltate scales. *Aglaia eximia* sometimes flowers as a small tree.

19. Aglaia argentea Blume

Aglaia argentea Blume, Bijdr. (1825) 170; Miq., Fl. Ind. Bat., Suppl. 1 (1861) 543; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 54; King, J. As. Soc. Beng. 64, ii (1895) 70; Koord., Atlas 1 (1913) t. 151; Ridley, Fl. Malay Penins. 1 (1922) 405; Backer & Bakh. f., Fl. Java 2 (1965) 129; Pannell in Tree Fl. Malaya 4 (1989) 211; Kew Bull., Add. Ser. 16 (1992) 125, f. 27.

?[*Milnea argentea* Reinw., Gewassen Hort. Buitenzorg (1823) 71, nom. nud.]

Aglaia hypoleuca Miq., Fl. Ind. Bat., Suppl. 1 (1861) 197, 507. — *Aglaia argentea* Blume var. *hypoleuca* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 55.

Aglaia speciosa auct. non Blume: Teijsm. & Binn., Cat. Hort. Bogor. (1866) 211.

Aglaia argentea Blume var. *angustata* Miq., var. *borneensis* Miq., var. *microphylla* Miq., var. *superba* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 55.

Aglaia argentea Blume var. *curtisii* King, J. As. Soc. Beng. 64, ii (1895) 71.

Aglaia argentea Blume var. *cordulata* C.DC. in DC., Monogr. Phan. 1 (1878) 618.

Aglaia argentea Blume var. *multijuga* Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 165.

Aglaia argentea Blume var. *splendens* Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 166. — *Aglaia splendens* (Koord. & Valeton) Koord. & Valeton, Ic. Bogor. (1897) t. 14.

Aglaia bauerlenii C.DC., Bull. Herb. Boiss. II, 3 (1903) 175.

Aglaia multifoliola Merr., Philipp. J. Sc., Bot. 9 (1915) 534.

Aglaia discolor Merr., Univ. Calif. Publ. Bot. 15 (1929) 130.

Tree up to 30 m, sometimes flowering and fruiting at 4.5 m. Bole up to 18 m, up to 60 cm in diam.; with buttresses to 1 m high and to 1 m out, c. 4 cm thick. Bark smooth, brown or greyish-green, longitudinally lenticellate; inner bark white, yellow or brown; sapwood pale brown, brown or reddish-brown; latex white, when present. *Twigs* stout, thickly covered with pale brown or white peltate scales which have a darker centre. *Leaves* in spirals particularly towards the ends of the twigs where they are close together, imparipinnate, 17–112 cm long and 14–75 cm wide; petiole 4–41 cm, petiole, rachis and petiolules ridged and with indumentum like the twigs. *Leaflets* 9–19, 4.5–30 (–33) by 1.5–11(–14) cm, often shiny above, subcoriaceous, acuminate at apex, usually rounded to an asymmetrical subcordate base, sometimes cuneate, especially on the terminal leaflet, both surfaces covered with peltate scales when young, when mature upper surface glabrous, the lower surface thickly covered with white peltate scales with few to numerous brown peltate scales interspersed, both types of scales often having a shortly fimbriate margin; veins 11–25 on each side; petiolules 5–10 mm on lateral leaflets, 10–120 mm on terminal leaflets. *Inflorescence* up to 60 cm long and 60 cm wide,

in the axils of the leaves near the apex of the shoot; peduncle up to 15 cm, peduncle, rachis, branches, pedicels and calyx with indumentum like the twigs. Male and female *flowers* similar, 2–4 mm long and 1.5–2.5 mm wide, ellipsoid, sessile or occasionally with pedicels up to 2.5 mm long. *Petals* 5, with some scales on the outside when young. *Staminal tube* shorter than the corolla, obovoid, aperture 0.5–0.6 mm across with an entire or shallowly 5-lobed margin, anthers 5, ovoid, included or just protruding. *Infructescence* 20–50 cm long, 25–35 cm wide; peduncle c. 14 cm, the peduncle, rachis and branches with indumentum like the twigs. *Fruits* 3–3.5 cm long and 2–3 cm wide, ovoid or obovoid, with a short stipe up to 0.5 cm long, pericarp yellow or brown, densely covered with scales like those on the twigs, sometimes glabrescent; latex white; locules 2 (or 3) each containing 0 or 1 seed. *Seeds* completely surrounded with a soft, white, sweet or sweet-sour aril.

Distribution — Nicobar Islands, Thailand, Solomon Islands, Australia (Cape York Peninsula); *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, Lesser Sunda Islands, Moluccas, New Guinea.

Habitat & Ecology — Found in primary, secondary and riverine forest, evergreen or semi-evergreen, on granite, basalt, sandstone, coral sand, clay or limestone; sealevel up to 1200 m altitude; scattered to locally rather common. Aril eaten by monkeys, hornbills, children.

Uses — The timber is not durable [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 73].

Note — The lower surface of the leaflets has a dense indumentum of white or brown peltate scales, the former gives them a silvery appearance, hence the specific epithet. There are at least two forms of this species, linked by intermediates; one has a darker indumentum, the lateral veins on the lower leaflet surface are prominent and the leaflet has a subcordate base; the other is less robust, the indumentum is white, the lateral veins are not prominent and the leaflet base is cuneate. Both are often found in secondary and regenerating forest and forest edge. The form with the darker indumentum is, for example, conspicuous by its copper crown in the ravine along which the Padang–Bukittinggi road runs in West Sumatra. In addition to these two forms, some collections from Thailand have small, coriaceous leaflets which are shiny dark brown above when dry.

20–22. Aglaia squamulosa group

The following three species are characterized by their large, entire, peltate scales, 0.1–0.25 mm across, thickly covering the twigs and numerous or forming a dense cover on the lower surface of the leaflets. The species differ in the size and number of the leaflets, in the extent to which the leaflet surfaces are rugose and in the colour of the scales. All three species have pale brown stellate or simple hairs on the anthers and inside the staminal tube. The fruits of *A. squamulosa* are sometimes spindle-shaped, in *A. densisquama* they are always so and in *A. subcuprea* they are obovoid.

20. Aglaia squamulosa King

Aglaia squamulosa King, J. As. Soc. Beng. 64, ii (1895) 68; Ridley, Fl. Malay Penins. 1 (1922) 407; Pannell in Tree Fl. Malaya 4 (1989) 225; Kew Bull., Add. Ser. 16 (1992) 129, f. 30.
[*Aglaia cuprea* Elmer, Leafl. Philipp. Bot. 9 (1937) 3287, sine diagn. lat.]

Tree up to 20 m, usually with a broad rounded crown. Bole up to 15 m, up to 120 cm in circumference, with watery exudate when cut, sometimes with L-shaped buttresses upwards up to 55 cm and outwards up to 36 cm. Outer bark brown, pale green, pale orange-brown, pinkish-brown, pale brownish-grey or grey, sometimes with transverse and longitudinal striations or rows of lenticels; inner bark yellowish-brown, orange or green; sapwood brown or pale yellowish-pink, pale brown or orange; heartwood magenta, sometimes with white latex. *Twigs* stout, thickly covered with peltate scales which have a brown centre and pale brown shortly fimbriate margin. *Leaves* in spirals which become dense towards the ends of the twigs, imparipinnate, up to 90 cm long and 60 cm wide; petiole up to 20 cm, petiole, rachis and petiolules ridged and with indumentum like the twigs, but the scales sometimes brown throughout. *Leaflets* 9–15, 4–30 by 2–10 cm, dark yellowish-green on upper surface, paler on lower surface, coriaceous, recurved at the margin, acuminate at apex, rounded or cuneate at the asymmetrical base, when young both surfaces densely covered with pale brown or colourless, shiny, peltate scales, when mature upper surface rugose and with a few scattered scales, lower surface with numerous to densely covered with scales, those on the main veins reddish-brown; veins 4–13 on each side of the midrib; petiolules 3–20 mm. Male *inflorescence* up to 39 cm long and 20 cm wide; peduncle up to 9 cm long, peduncle, rachis, branches and pedicels thickly covered with scales like those on the twigs. *Male flowers* up to 2 mm in diam., subglobose, fragrant; pedicels up to 1 mm long. *Calyx* with few to densely covered with peltate scales. *Petals* 5. *Staminal tube* c. 1 mm long, 1 mm wide, obovoid, the aperture c. 0.5 mm across, shallowly 5-lobed, with white stellate hairs in dense clumps on the inner surface of the tube near the apex and few on the outer surface; anthers c. 0.5 mm long, 0.3 mm wide, ovoid, reaching or protruding just beyond the aperture, densely covered with white stellate hairs. *Female flowers* similar to the male but up to 5 mm long, obovoid; sessile or with pedicels up to 1 mm; anthers c. 1/3 the length of the tube and inserted in the upper 1/2 or 1/3. *Fruits* narrowly obovoid when young, up to 5 cm long, 3.5 cm wide and subglobose, often with a short beak up to 5 mm and a short stipe up to 5 mm when mature, brown or yellow, densely covered with brown peltate scales. Locule 1, containing one *seed*; aril translucent, white.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines, Celebes, Lesser Sunda Islands (Sumbawa).

Habitat — Found in primary and secondary forest on sandstone, sand, clay, loam; 17 to 2000 m altitude.

Note — *Aglaia squamulosa* is readily distinguished by the markedly rugose upper surface of the leaves and the numerous peltate scales on the lower surface from which the specific epithet is derived. *Aglaia densisquama*, which is known only from Sarawak, appears to be an extreme but distinct variant of *A. squamulosa* and is treated here as a

separate species. It has spindle-shaped fruits, which are rarely found in *A. squamulosa* in Borneo (e.g. in *Chai S 36154*).

21. Aglaia densisquama Pannell

Aglaia densisquama Pannell, Kew Bull., Add. Ser. 16 (1992) 133.

Tree up to 20 m. Bole up to 1 m in circumference. Bark smooth, with longitudinal cracks. Wood pink, becoming darker towards the centre; without latex. *Twigs* densely covered with peltate scales which are 0.3–0.4 mm in diam. and dark reddish-brown with a pale margin. *Leaves* imparipinnate, up to 48 cm long and 44 cm wide; petiole 8–16 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 9–11, 7–22 by 4–8 cm, coriaceous, pale yellowish-green on upper surface when dry, elliptical or ovate, recurved at margin, caudate-acuminate at apex, rounded or cuneate at the markedly asymmetrical base, the upper surface of the leaflet rugulose and pitted, the midrib and veins on the upper surface and the entire lower surface densely covered with scales like those on the twigs; veins 7–17 on each side; the midrib and lateral veins markedly depressed on the upper surface and subprominent on the lower; petiolules up to 15 mm. Male *inflorescence* c. 42 cm long and 42 cm wide; peduncle 7.5–11 cm; female inflorescence c. 28 cm long and 4 cm wide; peduncle up to 8 cm; peduncle, rachis and branches longitudinally wrinkled and densely covered with scales like those on the twigs. *Flowers* c. 3 mm long and 3–4 mm wide; pedicels c. 1.5 mm, the pedicels and calyx densely covered with scales like those on the twigs. *Petals* 5, with a few scales like those on the twigs on the outer surface. *Staminal tube* 1.5–1.7 mm long and 2.2–2.5 mm wide, depressed-globose, the aperture c. 0.7 mm in diam.; anthers 5, 0.5–0.8 mm long and 0.4–0.5 mm wide, ovoid, inserted about 2/3 of the way up the staminal tube and just protruding through the aperture, the staminal tube thick and fleshy below and between the anthers. *Infructescence* 30–40 cm long, 18–20 cm wide; peduncle 2–8 cm, the peduncle, rachis and branches longitudinally wrinkled and densely covered with scales like those on the twigs. *Fruits* up to 5 cm long and 2 cm wide, narrowly ellipsoid, ovoid or obovoid with a long narrow beak up to 1.5 cm long and a short broad stipe up to 5 mm long; the pericarp densely covered with scales like those on the twigs and without latex. Locules 2, each containing one *seed* which has an entire, translucent, white aril.

Distribution — *Malesia:* Borneo (Sarawak).

Habitat — Found in primary, including riverine, forest; on alluvial sand with some clay and on clayey loam; 15 to 1600 m altitude.

Note — *Aglaia densisquama* resembles *A. squamulosa* but the indumentum is darker in colour and the leaflet margin is strongly recurved. In *A. densisquama* the dense indumentum of bright, shiny, dark reddish-brown peltate scales on the lower surface of the leaflet contrasts with the pale yellowish-green upper surface of the leaflet. The midrib and lateral veins are markedly depressed on the upper surface and the lateral veins anastomose and appear as conspicuous loops near the margins of the leaflets. The leaflets have a long, caudate apex and the fruits are spindle-shaped with a long, narrow beak.

22. Aglaia subcuprea Merr. & L.M. Perry

Aglaia subcuprea Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 324; Pannell, Kew Bull., Add. Ser. 16 (1992) 135.
Aglaia versteeghii Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 323.
Aglaia boanana Harms, Bot. Jahrb. 72 (1942) 163.

Tree 4–30 m, bole diameter up to 1.6 m. Outer bark fairly smooth, brown or black, mottled with grey and fawn in large patches, sometimes flaking in small irregular scales; inner bark pale brown to reddish-brown. Sapwood cream, pink, red or dark red, latex white. *Twigs* slender to fairly stout, thickly covered with pale brown, reddish-brown or pale orange-brown peltate scales 0.1–0.25 mm diam., which have a dark centre and a paler fimbriate margin. *Leaves* up to 67 cm long and 45 cm wide; petiole up to 17 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (3–)7–9(–11), 5–24 by 2.5–8 cm, coriaceous or subcoriaceous, sometimes recurved at the margin, cuneate at the asymmetrical base, usually with a broad rounded apex, but sometimes acuminate at apex; with scales like those on the twigs densely covering both surfaces when young, glabrescent on upper surface leaving it wrinkled or pitted, sometimes glabrescent on lower surface; veins 6–15 on each side of the midrib; petiolule up to 10(–20) mm on lateral leaflets. *Inflorescence* up to 30 cm long and 20 cm wide, peduncle, rachis, branches, pedicels and calyx thickly covered with scales like those on the twigs. Male *flowers* 2–4 mm long, 2–3 mm wide, female flowers 4.5–5 mm long, c. 3.5 mm wide; pedicel 1–5 mm. *Petals* 5, white, pale yellow or yellow, aestivation quincuncial. *Staminal tube* 1.3–3 mm long, 1.2–2.5 mm wide, obovoid, aperture 1–1.4 mm across and shallowly 5- (or 6-)lobed; anthers 5(–10), 0.6–1.5 mm long, 0.3–0.5 mm wide, ellipsoid or ovoid, inserted 1/3 to 2/3 of the way up the staminal tube and usually protruding through the aperture; with few to numerous stellate hairs or peltate scales on the anthers and the inside of the staminal tube. *Ovary* c. 0.6 mm high and 0.7 mm wide, subglobose; locule(s) 1 or 2, each containing 1 ovule; stigma 0.7–1.5 mm long, 0.3–0.4 mm wide, ovoid to fusiform with 2 small apical lobes. *Infructescence* 12–23 cm long, up to 14 cm wide; peduncle up to 5.5 cm, peduncle, rachis, branches and pericarp densely covered with scales like those on the twigs. *Fruits* c. 2.7 cm long and 1.5 cm wide, obovoid, sometimes with numerous wart-like bumps on the outside; locules (1 or) 2, each with 0 or 1 seed. *Seeds* with a pale yellow aril.

Distribution — ?Solomon Islands; *Malesia:* New Guinea, New Ireland.

Habitat — Found in periodically inundated primary forest, secondary forest, lowland and montane forest, riverine forest; on sandy clay, granite; 5 to 2570 m altitude; rare to rather common.

Uses — The wood is used for bullock-carts in Sulau, Minahasa (Celebes).

Note — The lower surface of the leaflets of *A. subcuprea* is densely covered with peltate scales varying in colour from pale orange to dark reddish-brown. Size and leatheriness of the leaflets is also variable. A variant with small, coriaceous leaflets with a recurved margin includes the type of *A. versteeghii* and may represent a subspecies, an impression based solely on leaf characters. Supporting flower or fruit characters and information on ecological or distributional differences from the rest of *A. subcuprea* are lacking.

23. Aglaia lancilimba Merr.

Aglaia lancilimba Merr., Philipp. J. Sc., Bot. 13 (1918) 294; Pannell, Kew Bull., Add. Ser. 16 (1992) 137.

Tree 1–15 m. *Twigs* densely covered with large shiny reddish-brown peltate scales which are entire or have a short fimbriate margin and often have a dark centre and a dark ring near the margin, usually 0.3–0.6 mm in diam., sometimes smaller. *Leaves* 18–50 cm long, 14–34 cm wide, petiole 2.5–12 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (7–)9–13(–17), 5–18 by 1.5–5.5 cm, pale yellowish-brown and usually with the margin recurved or undulate when dry, apex acuminate, cuneate or rounded at the asymmetrical base; with scales like those on the twigs thickly covering the midrib on the lower surface, sometimes with a few paler and more fimbriate scales interspersed, occasional on the rest of that surface, the lower surface with numerous pits, veins 6–17 on each side; petiolules 5–15(–20) mm on lateral leaflets, up to 20 mm on the terminal leaflet. *Inflorescence* up to 28 cm long and 23 cm wide; peduncle 5–15 mm, peduncle, rachis, branches, pedicels and calyx densely covered with scales like those on the twigs or with scales which have a longer fimbriate margin or are stellate. *Flowers* 1.5–3 mm long, 1.5–3.5 mm wide, pedicel 0.5–2 mm. *Petals* 5. *Staminal tube* up to c. 1 mm long, 1–2 mm wide, shallowly cup-shaped, thickened below and between the anthers, the aperture 0.6–1.3 mm across and with the margin shallowly lobed; anthers 5, 0.4–0.5 mm long and 0.4–0.5 mm wide, dark blackish-brown when dry with a pale yellow margin, inserted inside the margin of the tube and protruding. *Stigma* 0.2–0.3 mm long and 0.3–0.4 mm wide, ovoid, truncate at the apex. *Infructescence* up to 19 cm long and 5.5 cm wide, peduncle 2.5 cm; the peduncle, rachis and branches densely covered with scales like those on the twigs. *Fruits* 2.2–3 cm long and 2.2–3 cm wide, subglobose, brown or yellow when ripe; the pericarp thin and brittle when dry, densely covered with scales like those on the twigs on the outside; locules 2 (or 3), each containing one seed. *Seed* covered with a white aril.

Distribution — *Malesia:* E Borneo (Bumbun Is.), Philippines, Celebes, Lesser Sunda Islands (Bali, Sumbawa, Flores).

Habitat — Found in primary forest, including swamp forest, montane forest, semi-wet forest; 1 to 1400 m altitude; common.

Note — *Aglaia lancilimba* has relatively narrow leaflets, pale green below when dry, with large peltate scales which often densely cover and are conspicuous on the midrib of the lower surface of the leaflets but are few on the rest of that surface.

24. Aglaia lepiorrhachis Harms

Aglaia lepiorrhachis Harms, Bot. Jahrb. 72 (1942) 165; Pannell, Kew Bull., Add. Ser. 16 (1992) 139.

Tree 4–7 m tall, c. 8 cm in diam. Outer bark smooth, pale grey or greyish-brown; inner bark pale yellowish-brown or pale brown. *Twigs* densely covered with large

shiny pale brown, peltate scales which have a fimbriate margin. *Leaves* imparipinnate, up to 80 cm long, petiole to 16 cm long, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 7–9, 14–30 by 4–10 cm, the apex acuminate, cuneate at the slightly asymmetrical base, upper surface rugulose and pitted, lower surface with numerous dark, shallow pits, with scales like those on the twigs, densely covering the midrib and scattered on the lower surface; veins 13–19 on each side of the midrib. *Inflorescence* c. 30 cm long and 30 cm wide; peduncle up to 5 cm, peduncle, rachis and branches densely covered with scales like those on the twigs. Male *flowers* up to 2.5 mm long and 2 mm wide; pedicels up to 2 mm, densely covered with scales like those on the twigs. *Calyx* with few or no scales on the outside. *Petals* 4 or 5(–7). *Staminal tube* about 2/3 the length of the petals, cup-shaped or obovoid, the apical margin shallowly lobed and with simple hairs; anthers 4 or 5, about half the length of the tube, inserted 2/3–3/4 up the tube and protruding for half the anther length, with a few simple or stellate hairs. *Fruits* solitary, c. 3.5 cm long and 3.5 cm wide; pedicel 0.5 cm, with numerous reddish-brown peltate scales which have a fimbriate margin on the pedicel and calyx and few paler scales on the outside of the pericarp. Locules 2, each containing one *seed* which is surrounded by a gelatinous aril.

Distribution — *Malesia:* New Guinea.

Habitat — Lowland and hill forest; up to 600 m altitude.

Note — *Aglaia lepiorrhachis* resembles *A. lancilimba* in that it has large, shiny, brown, peltate scales densely covering the midrib on the lower surface of the leaflets. It differs from the latter species in the paler colour of the scales and in its usually larger leaflets which have more numerous lateral veins. *Aglaia lancilimba* is not found east of Celebes and *A. lepiorrhachis* is confined to the island of New Guinea.

25. Aglaia elaeagnoidea (A. Juss.) Benth.

Aglaia elaeagnoidea (A. Juss.) Benth., Fl. Austral. 1 (1863) 383, p.p.; Koord., Atlas 1 (1913) t. 154; Backer & Bakh. f., Fl. Java 2 (1965) 128; Mabb. in Fl. Nouv.-Caléd. et Dép. 15 (1988) 75; Pannell, Kew Bull., Add. Ser. 16 (1992) 143, f. 34. — *Nemedra elaeagnoidea* A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 239; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 223, 269, t. 14 ('1830').

Aglaia odoratissima auct. non Blume: Benth. in Hook., Lond. J. Bot. 2 (1843) 213, quoad specim.

Aglaia lepidota Miq., Fl. Ind. Bat., Suppl. 1 (1861) 507.

Aglaia lepidota Miq. var. *paupercula* Miq., l.c. — *Aglaia roxburghiana* (Wight & Arn.) Miq. var. *paupercula* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 42.

Aglaia roxburghiana (Wight & Arn.) Miq., Ann. Mus Bot. Lugd.-Bat. 4 (1868) 41, incl. var. *angustata* Miq. & var. *balica* Miq.; Koord., Atlas 1 (1913) t. 161; Hiern in Hook. f., Fl. Brit. India 1 (1875) 555; Kurz, J. As. Soc. Beng. 44, ii (1875) 147. — *Milnea roxburghiana* Wight & Arn., Prodr. (1834) 119.

[*Aglaia spanoghei* Blume ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 41, nom. nud., in syn.]

Aglaia canariifolia Koord., Minah. (1898) 380, 633.

Aglaia elaeagnoidea (A. Juss.) Benth. var. *glabrescens* Valeton in Hochr., Plant. Bogor. Exs. (1905).

Aglaia parvifolia Merr., Philipp. Govt. Lab. Bur. Bull. 29 (1905) 21.

Aglaia elaeagnoidea (A. Juss.) Benth. var. *pallens* Merr., Philipp. J. Sc., Bot. 3 (1908) 413. — *Aglaia pallens* (Merr.) Merr., Philipp. J. Sc., Bot. 13 (1918) 297.

Aglaia cupreolepidota Merr., Philipp. J. Sc. 20 (1922) 393 ('*cupreo-lepidota*').

Small tree or shrub 5–10(–20) m; bole up to 25(–50) cm in diam., sometimes with small buttresses. Outer bark brown, greyish-brown or yellowish-grey, with lenticels and narrow vertical fissures, flaking in thin, irregular, stiff scroll-like scales; inner bark pink or reddish-brown; sapwood yellow; heartwood red. *Twigs* densely covered with pale brown or pale orange-brown peltate scales which have a short fimbriate margin. *Leaves* imparipinnate, 6–29 cm long, 7–21 cm wide; petiole 2.5–10.5 cm, petiole, rachis and petiolules densely covered with peltate scales like those on the twigs. *Leaflets* (1–)3–7, 2–13(–16) by 1–5(–6) cm, subcoriaceous, the apex rounded or acuminate, cuneate at the asymmetrical base, upper surface shiny, with scales like those on the twigs, densely covering both surfaces of the leaflets when young, numerous on or densely covering the midrib and sparse to numerous elsewhere when mature, with numerous faint or conspicuous pits on both surfaces, lateral veins 5–10 on each side of the midrib, the reticulation sometimes subprominent on both surfaces; petiolules 5–15(–20) mm on lateral leaflets. Male *inflorescence* (3–)9–34 cm long and (1–)2.5–25 cm wide; female inflorescence up to 12.5 cm long and 10 cm wide; peduncle up to 6 cm, peduncle, rachis and branches with indumentum like the twigs. *Flowers* up to 3 mm long and in diam.; pedicel 0.5–1.5 mm, densely covered with scales like those on the twigs. *Calyx* densely covered with scales like those on the twigs. *Petals* 5. *Staminal tube* nearly as long as the corolla, subglobose, yellow, the aperture 0.3–0.7 mm across with a dentate margin; anthers 5, about half the length of the tube, inserted half way up the tube with their apices usually just protruding through the aperture. *Infructescence* up to 12 cm long and 10 cm wide; peduncle up to 5 cm, the peduncle, rachis, branches and fruitstalks densely covered with peltate scales like those on the twigs. *Fruits* 1.1–2 cm long, 1.3–1.5 cm in diam., subglobose, ellipsoid or obovoid, orange, brown or red, indehiscent, densely covered with scales like those on the twigs, sometimes glabrescent; pericarp thin, soft. Locules 2, each with 0 or 1 seed. *Seed* c. 10 mm long, 6 mm wide and 3 mm thick, usually completely covered with a thin, white, gelatinous, sweet aril.

Distribution — India, Sri Lanka, Taiwan (southern cape), Vietnam, Cambodia, Thailand, Australia (Western Australia and Queensland), Vanuatu, New Caledonia, Samoan Islands; *Malesia:* Sumatra (Bangka & Belitung), Malay Peninsula, Borneo, Java, Philippines, Celebes, Bali, Moluccas, New Guinea.

Habitat — Found in secondary forest, deciduous forest, along beaches, river banks, and in *Barringtonia* formation on sand, granite, coral and limestone; sealevel to 1000 m altitude; rather common.

Uses — Aril edible, sweetish, tasty.

Note — *Aglaia elaeagnoidea* is a widespread, variable species which occurs throughout the range of the genus except for the Solomon Islands and it extends beyond the range of all other species in the genus in Western Australia. It is most frequent in the non-equatorial parts of the range of *Aglaia*, which have a more seasonal climate. *Aglaia elaeagnoidea* is usually coastal, especially in the east of the range. The large pale orange or almost white peltate scales are characteristic, but they vary in colour, and in their density on the plant. In the eastern part of the range, the scales are larger and paler in colour than in the west, the density is greater on the leaves, but the fruits may have fewer scales.

26. Aglaia smithii Koord.

Aglaia smithii Koord., Minah. (1898) 383, 635; Pannell, Kew Bull., Add. Ser. 16 (1992) 150.
[*Aglaia dysoxylonoides* Koord., Minah. (1898) 380, nom. nud., p.p., quoad specim.]
Aglaia bicolor Merr., Philipp. J. Sc., Bot. 4 (1909) 270.
Aglaia badia Merr., l.c.
Aglaia ramosii Quisumb., Philipp. J. Sc. 41 (1930) 326, t. 6.

Tree up to 10 m. *Twigs* densely covered with dark reddish-brown peltate scales which are depressed and very dark in the centre and have a paler, irregular margin. *Leaves* 27–47 cm long; petiole 6–8 cm long, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (?5–)9–15, 7–17(–19) by 2–6(–8) cm, acuminate at apex, usually cuneate, sometimes rounded at the very asymmetrical base, with numerous pits or scales like those on the twigs on the upper surface, densely covered with scales like those on the twigs and a few larger and darker ones interspersed on the lower surface; veins 9–13 on each side of the midrib; petiolule 5–15(–20) mm. *Inflorescences* in the axils of several leaves near the apex of the shoot, up to 28 cm long; peduncle c. 6 cm, peduncle, rachis and branches densely covered with scales like those on the twigs. *Flowers* c. 2.5 mm long and 3.5 mm wide; pedicels c. 3 mm, the pedicels and calyx densely covered with orange-brown scales which have a paler margin. *Petals* 5. *Staminal tube* c. 2 mm long and 3 mm wide, the aperture with 10 triangular lobes which have stellate yellow hairs on their margins; anthers 5, c. 0.7 mm long and 0.4 mm wide, inserted below the margin, with yellow stellate hairs, the staminal tube thickened below and between the anthers. *Infructescence* c. 18 cm long and 16 cm wide; peduncle 3–4 cm, the peduncle, rachis and branches densely covered with scales like those on the twigs. Unripe *fruits* c. 1 cm long, obovoid, with numerous bumps and densely covered with scales on the outer surface.

Distribution — *Malesia:* Philippines (Palawan and Basilan), Lesser Sunda Islands, Moluccas (Tanimbar I.), New Guinea (Adi I.).

Habitat — Found in primary and coastal forest on clay; sealevel to 40 m altitude; rather scarce to common.

Uses — Wood is used for poles (Irian Jaya, Fakfak, Kembala).

Note — The indumentum in *Aglaia smithii* is similar to that of *A. korthalsii* and *A. speciosa*, but it is usually much more dense. *Aglaia smithii* occurs only in Wallacea.

27. Aglaia variisquama Pannell

Aglaia variisquama Pannell, Kew Bull., Add. Ser. 16 (1992) 153.

Tree up to 20 m, with few branches and a small, compact crown. Bole up to 15 m, up to 1 m in circumference. Outer bark smooth, green, brown, reddish-grey or black; inner bark pale yellow or red; cambium white, sapwood pale yellow. *Twigs* densely covered with dark orange-brown peltate scales which are up to 0.3 mm in diam. and have an irregular margin, with some scales which have a dark orange-brown centre and paler margin interspersed. *Leaves* imparipinnate, up to 79 cm long and 58 cm wide; petiole 7–15 cm, petiole, rachis and petiolules densely covered with scales like those on

the twigs. *Leaflets* 9–13, 7.5–30 by 4–13 cm, coriaceous, obovate, recurved at the margin, acuminate at the apex, cuneate at the base, the lower surface of the leaflet with numerous scales like those on the twigs, the scales evenly distributed and visible to the naked eye as tiny dark and pale brown spots; veins 10–17 on each side of the midrib; petiolules 5–19 mm. *Inflorescence* up to 32 cm long and 22 cm wide, in the axils of c. 3 leaves near the apex of the shoot; peduncle 1.5–10 cm, the peduncle, rachis and branches densely covered with scales like those on the twigs. *Male flowers* c. 1.5 mm long and 2 mm wide, depressed-globose; pedicels up to 1.5 mm, the calyx and pedicels with numerous pale peltate scales which have a fimbriate margin. *Petals* 5. *Staminal tube* c. 1.2 mm long and 1.5 mm wide, depressed globose, the aperture c. 0.5 mm in diam.; anthers 5, inserted about half way up the staminal tube and just protruding through the aperture, with a few simple hairs at the base and apex of each anther and on the inner surface of the staminal tube, the staminal tube with longitudinal, thickened ribs, one below each anther and one between each pair of adjacent anthers. *Female flowers* c. 3 mm long and 4 mm wide, depressed-globose; sessile. *Petals* 6, thick and fleshy, with few orange-brown or pale orange-brown peltate scales which have a fimbriate margin and a dark central spot on the outer surface. *Staminal tube* c. 1.8 mm long, 1.7–2 mm wide with a few pale brown stellate scales on the outer surface, the aperture 0.5 mm in diam.; otherwise like the male. *Infructescence* c. 16 cm long and 10 cm wide. *Fruits* c. 4 cm long and wide, subglobose, sometimes with a small beak, yellowish-brown, indehiscent, densely covered with pale orange-brown peltate scales on the outer surface; latex white. *Seed* 1, with a fleshy translucent aril; testa dark brown.

Distribution — *Malesia:* Peninsular Malaysia, Borneo.

Habitat — Found in secondary forest, primary forest, kerangas, swamps and along rivers; on sand; 200–430 m altitude; scattered.

Note — *Aglaia variisquama* resembles *A. squamulosa* but the twigs are stouter, the leaves more coriaceous and the scales darker and not densely covering the lower leaflet surface. The evenly distributed dark orange-brown scales with paler scales interspersed is similar to the indumentum on the lower surfaces of the leaflets of *A. rimosa*.

28. Aglaia rimosa (Blanco) Merr.

Aglaia rimosa (Blanco) Merr., Sp. Blanc. (1918) 212; Pannell, Kew Bull., Add. Ser. 16 (1992) 156. — *Portesia rimosa* Blanco, Fl. Filip. (1837) 297. — *Trichilia rimosa* (Blanco) Blanco, Fl. Filip., ed. 2 (1845) 250; ed. 3, 2 (1878) 99.
Aglaia denticulata Turcz., Bull. Soc. Imp. Nat. Mosc. 31 (1858) 410 ('*Aglaja*').
Aglaia hexandra Turcz., l.c. ('*Aglaja*').
Aglaia macrobotrys Turcz., op. cit. (1858) 409 ('*Aglaja*').
Aglaia batjanica Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 46.
Aglaia llanosiana C.DC. in DC., Monogr. Phan. 1 (1878) 621.
Aglaia goebeliana Warb., Bot. Jahrb. 13 (1891) 345.
Aglaia elliptifolia Merr., Philipp. J. Sc., Bot. 3 (1909) 413.
Aglaia lanceolata Merr., Philipp. J. Sc., Bot. 5 (1910) 184.
Aglaia loheri Merr., Philipp. J. Sc., Bot. 9 (1915) 533.
Aglaia diffusiflora Merr., Philipp. J. Sc. 14 (1919) 410.
[*Aglaia bulusanensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 373, pro syn.]

[*Aglaia subviridis* Elmer ex Merr., op. cit. (1923) 373, pro syn.; Elmer, Leafl. Philipp. Bot. 9 (1937) 3312, sine diagn. lat.]

[*Aglaia reticulata* Elmer ex Merr., op. cit. (1923) 377, pro syn.; Elmer, op. cit. (1937) 3306, sine diagn. lat.]

Shrub or tree, 2–30 m high. Bole 5–52 cm in diam. with buttresses upwards up to 50 cm, outwards up to 1 m, and up to 3 cm thick. Outer bark dark brown to greenish-grey, scaly, with small lenticels, c. 2 mm thick; middle bark green; inner bark pink to dull red, with white latex. Sapwood white to orange-yellow; heartwood red-brown. *Twigs* densely covered with peltate scales which are radiate and have a dark orange brown or dark reddish-brown centre with a paler margin, the margin irregular, entire or ragged (often fimbriate in New Guinea); the scales variable in size on any one plant, 0.15–0.3 mm in diam., the largest being on the apical bud. *Leaves* 30–70 cm long, 22–50 cm wide, petiole 7–26 cm; petiole, rachis and petiolules with few to densely covered with scales like those on the twigs. *Leaflets* (3–)9–11(–15), 5.5–23 by 1.5–8 cm (–10 cm wide in New Guinea), acuminate at apex, rounded or cuneate at the asymmetrical base; dark glossy green on upper surface and dull pale green on lower surface when fresh, orange, orange-brown, orange-green or pale green when dry, sometimes pitted on upper and lower surfaces, often rugulose on upper surface, with scales like those on the twigs scattered or numerous on the lower leaflet surface, with a few darker scales interspersed, numerous on to densely covering the midrib below, numerous on upper leaflet surface of young leaves, deciduous; veins 7–17(–20 in New Guinea) on each side, reticulation rarely subprominent; petiolules 0.5–2(–25) mm. Male *inflorescence* 13–36 cm long, 10–33 cm wide, peduncle c. 1.5 cm. Female inflorescence 6 cm long, 5 cm wide, peduncle c. 1 mm, branches with few to densely covered with peltate scales like those on the twigs. *Flowers* (1.1–)1.5–2.2(–2.5) mm long, (1.1–)1.7–2.2 mm wide; pedicel (0.3–)0.5–0.7 mm to articulation, subtending branchlet 1–1.5 mm, with few to densely covered with peltate scales. *Calyx* usually densely covered on the outside with scales like those on the twigs, sometimes with few or no scales, or with scales only near the junction with the pedicel. *Petals* 4 or 5, white to red, pale yellowish-brown when dry. *Staminal tube* (0.6–)0.8–1.2(–1.5) mm long, (0.8–)1–1.6 mm wide, obovoid or cup-shaped, aperture 0.7–1 mm, shallowly lobed, anthers 5 (or 6), 0.4–0.5 mm long, 0.2–0.4 mm wide, narrowly ovoid, curved inwards, with pale yellow margins and dark brown centre, usually inserted about 2/3 up the tube but sometimes lower down, protruding and with the apices pointing towards the centre of the flower, staminal tube thickened (not in New Guinea) below and between the anthers so that each anther occupies a depression, with simple hairs often densely covering the lower part of the staminal tube and between the anthers and along the margins of the anthers. *Infructescence* 8–36 cm long, 13 cm wide, peduncle up to 8 cm, densely covered with scales like those on the twigs. *Fruits* 1.3 cm diam. (–1.5 cm in New Guinea), dull orange to brown, obovoid or sometimes ellipsoid with a beak up to 5 mm long and narrowed to a stipe up to 5 mm long, the pericarp thin, rigid and brittle when dry, densely covered with scales on the outside, green on the inside, with latex; locules 2, each containing 0 or 1 seed. *Seed* surrounded by a translucent yellow aril.

Distribution — Taiwan; *Malesia:* Philippines, Celebes, Moluccas, New Guinea, New Britain and New Ireland.

Habitat — Found in secondary forest along rivers and along coast on limestone and sandy clay; sealevel to 1350 m altitude; rather scattered to common.

Note — *Aglaia rimosa* has a characteristic indumentum on the vegetative parts of the plant. This indumentum and the woolly white indumentum or white deposit in the staminal tube bring together a wide diversity in leaflet size and shape. However, there appears to be no consistent characters upon which the group can be subdivided. The species as defined here is recognizable with the naked eye because of the shiny peltate scales which look like evenly distributed orange dots on the lower surfaces of the leaflets.

29. Aglaia costata Merr.

Aglaia costata Merr., Philipp. J. Sc., Bot. 3 (1908) 146; Pannell, Kew Bull., Add. Ser. 16 (1992) 159. [*Aglaia umbrina* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 372, pro syn.; Elmer, Leafl. Philipp. Bot. 9 (1937) 3317, sine diagn. lat.]

Tree c. 6 m high, bole c. 10 cm in diam. *Twigs* densely covered with reddish-brown peltate scales which have a fimbriate margin. *Leaves* up to 55 cm long and 46 cm wide; petiole up to 22 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 9–11, 6–23 by 2.5–10 cm, acuminate at apex, rounded at the slightly asymmetrical base; veins 8–12 on each side of midrib, with pale orange brown peltate scales which have a fimbriate margin and a dark central spot numerous on the lower leaflet surface, with some darker orange brown scales which have an almost entire margin interspersed; petiolules 10–20 mm. *Inflorescence* c. 38 cm long and 28 cm wide; peduncle 8 cm, peduncle, rachis and petiolules densely covered with scales like those on the twigs. *Flower* c. 2.5 mm long and 2.5 mm wide; pedicel 1–3.5 mm, the pedicel and calyx densely covered with reddish-brown peltate scales which have a fimbriate margin. *Petals* 5. *Staminal tube* cup-shaped, 0.6 mm high, 1.6 mm wide; anthers 5, inserted just inside the margin of the tube, pointing towards the centre of the flower and occupying the entire aperture. *Infructescence* c. 17 cm long and 8 cm wide; peduncle c. 5.5 cm, the peduncle, rachis and pedicels densely covered with scales like those on the twigs. *Fruits* (1–)1.2–2 cm long and (1.5–)2 cm wide, subglobose or depressed-globose with 10 deep longitudinal grooves so that the fruit has 10 longitudinal lobes, densely covered with scales like those on the twigs; fruitstalks up to 2.5 cm. Locules 10, each containing 1 small *seed.*

Distribution — *Malesia:* Philippines (Samar, Mindanao).

Habitat — Hardly any information available (steep, densely wooded slopes at 100 m).

Note — This species resembles *A. rimosa* except in details of the trichome structure (in the Philippines, the scales of *A. rimosa* are entire, although they are fimbriate in New Guinea) and pigmentation (the outer two thirds of the scale is paler in *A. rimosa*) and in the distinctive fruits which have 10 longitudinal lobes and 10 locules, each of which contains 1 seed; the locule number in the flowers dissected was not clearly visible, but appeared to be 5. This fruit structure and these locule numbers are found in no other species of *Aglaia.*

30. Aglaia agglomerata Merr. & L.M. Perry

Aglaia agglomerata Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 322; Pannell, Kew Bull., Add. Ser. 16 (1992) 160.
Aglaia leeuwenii Harms, Bot. Jahrb. 72 (1942) 172.
Aglaia doctersiana Harms, Bot. Jahrb. 72 (1942) 170.

Tree 3–32 m, sometimes bearing fruit at 3–5 m; bole up to 19 m, 5–92 cm in diam., with buttresses upwards up to 2.5 m, outwards up to 3 m and 20 cm thick. Outer bark pale grey, greyish-brown or brown, smooth, with vertical lines of brown lenticels, inner surface yellow; middle bark greenish-yellow to dark red; inner bark yellow or reddish-yellow; sapwood yellow or pink; heartwood dark red or brown, aromatic; latex white. *Twigs* with numerous to densely covered with small, very dark reddish-brown peltate scales which have a paler and slightly irregular or fimbriate margin. *Leaves* imparipinnate, 20–50 cm long, 22–40 cm wide, obovate in outline; petiole 3–13 cm, petiole, rachis and petiolules with numerous to densely covered with scales like those on the twigs. *Leaflets* (7–)9–13, 8–20 by 2.5–7.5 cm, apex acuminate, rounded or cuneate at the slightly asymmetrical base, glossy green above, paler below, the upper surface with numerous pits and sometimes rugulose, with numerous to densely covered with scales like those on the twigs on the midrib and numerous on the surface below, with some pits interspersed; veins 11–19 on each side of the midrib; petiolules 5–10 mm. *Male inflorescence* 21 cm long, 10 cm wide, peduncle 4 cm, peduncle, rachis, branches, pedicels and calyx densely covered with reddish-brown peltate scales which have a fimbriate margin, or stellate scales. *Flowers* c. 1.5 mm long and 2 mm wide, depressed globose, fragrant; pedicels 0.5–3 mm. *Petals* 5, yellow, aestivation quincuncial. *Staminal tube* 0.7 mm long, 1 mm wide, cup-shaped, aperture 1 mm across, the margin shallowly lobed; anthers 5, ovoid, inserted 3/4 up the staminal tube and protruding for 2/3 of their length. *Female inflorescence* c. 11 cm long and 11 cm wide; peduncle 2–3 cm, with indumentum like the male. *Flowers* 2–2.5 mm long, 1.5–2.5 mm wide, subglobose; pedicels 0.5–1 mm. *Petals* 5. *Staminal tube* 1.2–1.5 mm long and wide, obovoid or subglobose, the aperture c. 0.7 mm wide, shallowly lobed or dentate, anthers 5, 1/2–2/3 as long as the tube, sometimes with a few simple hairs, just protruding through the aperture. *Infructescence* either with 1 or 2 large fruits or 8–10 cm long and 7–13 cm wide with up to 36 small fruits; peduncle 0.5–2.5 cm long. The *large fruits* up to 6.5 by 4 cm, obovoid or ellipsoid, reddish-brown or dull yellow, indehiscent, the pericarp thick, woody and wrinkled, densely covered with pale or reddish-brown peltate scales which have a fimbriate margin on the outside and yellow inside. *Seed* 1, with a complete pale yellow aril. The *small fruits* 1.7 cm long, 1.4 cm wide, obovoid, pericarp dull orange, 1–2 mm thick and soft when fresh, brittle when dry, indehiscent; locules 2, each containing one seed. *Seeds* c. 1.4 cm long, 1 cm across and 0.6 cm thick, with a complete translucent orange or white aril less than 1 mm thick and black testa.

Distribution — *Malesia:* New Guinea.

Habitat — Found in primary lowland to midmontane forest, secondary forest, river banks on clayey and volcanic soil, sometimes on limestone; 10–1800 m altitude; rare to sometimes relatively common, scattered.

Notes — 1. *Aglaia agglomerata* has numerous peltate scales on the lower leaflet surface. It resembles *A. crassinervia*, but the leaflets are more coriaceous and they have a recurved margin.

2. It is not clear whether the two forms of the fruits described reflect different stages of maturity or whether the plants with infructescences which have many small fruits belong to a variant distinct from that which has few large fruits.

31 & 32. Aglaia speciosa group

The *Aglaia speciosa* group clearly consists of more than two taxa, but with the material available it is only possible to separate *A. speciosa* and *A. korthalsii*, of which the latter is more widespread and variable. See Pannell, Kew Bull., Add. Ser. 16 (1992) 162–164 for discussion of the morphological variation in the group, and Pannell & Koziol, Phil. Trans. Roy. Soc. B 316 (1987) 303–333 for seed dispersal and aril biochemistry.

More complete material for the group throughout its range might result in the detection of patterns of variation which would allow the delimitation of reliably distinguishable species or subspecies. More information about the animals which eat the arils and disperse the seeds and about the biochemistry of the aril might result in an improved understanding of the biology of the different forms and the functional significance of the morphological variation.

Aglaia speciosa is here delimited on its higher number of leaflets, their narrow, usually elliptical, shape and the density of the indumentum on the lower surfaces of the leaflets, and in fruit type. *Aglaia korthalsii* usually has fewer than 7 leaflets, which are broader and have fewer scales than *A. speciosa*; it includes a wide range of fruit forms.

31. Aglaia speciosa Blume

Aglaia speciosa Blume, Bijdr. (1825) 171; Miq., Fl. Ind. Bat. 1 (1859) 543; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 46; Koord., Atlas 1 (1913) t. 162; Backer & Bakh. f., Fl. Java 2 (1965) 127; Pannell, Kew Bull., Add. Ser. 16 (1992) 164, f. 39, 41.

?*Aglaia speciosa* Blume var. *macrophylla* C.DC. in DC., Monogr. Phan. 1 (1878) 614.

Tree up to 35 m, bole up to 20 m, dbh up to 60 cm; buttresses outwards up to 1 m, upwards up to 5 m, the trunk fluted above. Bark reddish-brown, with small orange lenticels, inner bark magenta or pink, sapwood yellow, latex white. *Twigs* densely covered with peltate scales which have a dark reddish-brown centre and pale margin, barely fimbriate or with a short irregular fimbriate margin. *Leaves* 25–30 cm long, 22–24 cm wide; petiole 4.5–10 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (5–)7–11, 7–16 by 2.5–4 cm, narrowly elliptical or narrowly obovate, apex acuminate, base rounded or cuneate, with numerous scales like those on the twigs on the lower leaflet surface, sometimes deciduous and leaving that surface with numerous pits; veins 12–15 on each side of the midrib; petiolule 5–10 mm. *Inflorescence* up to 22 cm long, 20 cm wide; peduncle 0.5–4 cm, peduncle, rachis and branches densely covered with scales like those on the twigs. *Flowers* 1–1.75 mm long, 1–2 mm wide, pedicels 0.5–1.5 mm; the pedicel and calyx densely covered with peltate

scales which have a fimbriate margin. *Staminal tube* 0.5–1.2 mm long, 0.8–1.5 mm wide, cup-shaped or obovoid, anthers 5, inserted just inside the rim of tube and pointing towards the centre of the flower. *Infructescence* up to 21 cm long, 20 cm wide, peduncle 3–5 cm. *Fruits* 2.3–3 cm long, 1.7–2.7 cm wide, obovoid, orange or brown, indehiscent; fruitstalks up to 5 mm, pericarp c. 1 mm thick, brittle, without dehiscence lines, densely covered with scales either like those on the twigs or paler and more fimbriate; locule(s) (1 or) 2, each containing 0 or 1 seed. *Seed* arillate, the aril c. 2 mm thick, translucent, yellow or orange, edible, firmly adhering to the testa; seed without the aril c. 1.6 cm long, 1.3 cm wide and 0.8 cm through, the seed coat with branched venation.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Celebes.

Habitat — Found in primary forest, secondary forest, marsh forest and forest edges on loam with lime; 5–2200 m altitude.

Note — *Aglaia speciosa* usually has 7–11 leaflets, whereas *A. korthalsii* usually has 5 leaflets. In Borneo some, but not all, leaves on a specimen may have fewer than 7 leaflets, but then the dense indumentum of small peltate scales, which have a distinctly dark centre and clearly defined pale margin which is closely adherent to the leaflet surface, distinguish it from *A. korthalsii*. The 12–15 pairs of veins together with the indumentum of peltate scales only, distinguish *A. speciosa* from *A. odoratissima*, which has 5–9(–11) pairs of veins and a mixture of peltate and stellate scales. The stigma is often longer and narrower than in *A. korthalsii*. The fruit is similar to, but larger than that of *A. odoratissima*, and contains one or two seeds.

32. Aglaia korthalsii Miq.

Aglaia korthalsii Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 42; Pannell, Kew Bull., Add. Ser. 16 (1992) 167, f. 41.
Hearnia sarawakana C.DC. in DC., Monogr. Phan. 1 (1878) 632.
Aglaia cauliflora Koord., Minah. (1898) 381, nomen, 633.
Aglaia dysoxylifolia Koord., Minah. (1898) 634.
[*Aglaia dysoxylonoides* Koord., op. cit. (1898) 380, nom. nud. (= *Aglaia dysoxylifolia*).]
Aglaia celebica Koord., op. cit. (1898) 634.
Aglaia longipetiolulata Baker f., J. Bot. Lond. 62, Suppl. (1924) 20.
Aglaia confertiflora Merr., Univ. Calif. Publ. Bot. 15 (1929) 125.
Aglaia sp., Corner, Wayside Trees 1 (1940) 457, f. 151; ed. 3, 2 (1988) 496, f. 154.
Aglaia sp. 4: Pannell in Tree Fl. Malaya 4 (1989) 228.

Tree up to 26 m. Bole up to 16 m; up to 70 cm in diam.; with triangular buttresses outwards up to 1.5 m with exposed roots beyond, upwards up to 2 m, bole fluted above. Bark pale to dark reddish-brown or pinkish-brown or orange brown, sometimes with coarse longitudinal fissures or rows of lenticels, flaking in large irregular roundish scales, exposing orange or yellowish-green bark beneath; inner bark pink, dark greenish-pink or purplish-pink, fibrous; sapwood pale pink, pale yellow, yellow or white; latex white. *Twigs* with numerous to densely covered with shiny reddish-brown peltate scales which have a dark centre, becoming paler towards the margin or which are pale throughout, the margin irregular or shortly fimbriate, latex white. *Leaves* up to 40 cm long and 48 cm wide, obovate in outline; petiole 7–12 cm, petiole, rachis and petiolules

Fig. 35. *Aglaia korthalsii* Miq. Fruiting shoot. Cultivated tree near Kota Bahru, Kelantan, Malaysia (*Pannell 1452*). Photograph C.M. Pannell, 1979.

with numerous scales like those on the twigs. *Leaflets* (3–)5(–7), 8–27(–36) by (2.5–)3–8 cm, apex acuminate, usually rounded but sometimes cuneate at the asymmetrical base; with scales like those on the twigs few on the upper surface and scattered or numerous on the lower surface at fairly regular intervals, sometimes with faint reddish-brown pits; veins 10–25 on each side of the midrib; petiolules usually 5–10(–30) mm. *Inflorescences* borne in leaf axils or on old wood of the twigs. Male inflorescence up to 30 cm long and wide; peduncle 0.5–2 cm, peduncle, rachis and branches with numerous to densely covered with scales like those on the twigs. Female inflorescence like the male but often much smaller, with fewer branches and flowers. *Flower* c. 1.5–2 mm long and 1.6–2.5 mm wide; pedicel 0.8–3 mm; calyx with few to numerous peltate scales like those on the twigs, divided almost to the base into 5 rounded lobes which have fimbriate margins. *Petals* 5. *Staminal tube* 0.8 mm long, 1.9 mm wide, obovoid or cup-shaped with the apical margin incurved and shallowly 5-lobed; anthers 5, c. 0.4 mm long, ovoid, inserted inside the rim of the tube, protruding and pointing towards the centre of the flower. *Infructescence* up to 17 cm long and 14 cm wide, with up to 15 fruits; peduncle 1–2 cm, the peduncle, rachis and branches with numerous scales like those on the twigs. *Fruits* 2–4 cm long, 1–3.5(–5) cm wide, ellipsoid or subglobose, orange, densely covered with orange-brown peltate scales which have a fimbriate margin on the outside and with small longitudinal wrinkles, the pericarp indehiscent with a

dehiscence line running longitudinally around the fruit along which the ripe fruit breaks open when pressure is applied, the pericarp 1–10 mm thick, fibrous and flexible, with some white latex, the inner surface, without hairs or scales, shiny orange; fruitstalks 1–2 cm. Locules 2 (or 3), each containing 0 or 1 seed, septum persistent, up to 0.5 mm thick, membraneous. *Seeds* 1.5–2 cm long, 1–1.5 cm wide, 0.8 mm through, ellipsoid, with inner surfaces flattened; aril c. 2 mm thick, translucent yellow or pale orange, juicy or gelatinous, edible, sweet or rather bitter tasting, firmly attached to the testa especially at the hilum and main antiraphe vascular bundle, usually not quite complete on the antiraphe side, the seed coat with branched venation. 2n = 84 [Pannell, l.c. (1992) 21]. — **Fig. 35, 36.**

Distribution — NE India (Assam), Bhutan, Nicobar Islands, Burma, Vietnam, S Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines, Celebes, Lesser Sunda Islands (Sumbawa, Flores).

Habitat — Found in primary, including riverine and peat swamp, forest, secondary forest, along rivers and in villages; on clay, loam, limestone, sandstone, sand. Cultivated in Kelantan (NE Malay Peninsula); 5–1700 m altitude; rare to common.

Uses — Edible fruits. Timber used for house poles.

Note — *Aglaia korthalsii* is separated from *A. speciosa* by its usually 5 larger leaflets, less dense indumentum, and its fruits. The fruit of *A. korthalsii* is usually similar to that of *A. elliptica* in that it is indehiscent and has a longitudinal ridge along which the ripe pericarp splits into two if pressure is applied, but the indumentum is of peltate scales in *A. korthalsii*, whereas it is of stellate scales in *A. elliptica*. In Celebes, *A. korthalsii* is sometimes ramiflorous.

Fig. 36. *Aglaia korthalsii* Miq. Seeds, antiraphe and raphe sides, the antiraphe side with the aril incomplete. Data as in Fig. 35.

33. Aglaia scortechinii King

Aglaia scortechinii King, J. As. Soc. Beng. 64, ii (1895) 64; Ridley, Fl. Malay Penins. 1 (1922) 403; Pannell, Kew Bull., Add. Ser. 16 (1992) 175.

Tree up to 22(–30) m; bole 9 m, diam. 25 cm. Bark smooth, green, greyish-brown or reddish-brown, inner bark yellow, pale brown or pink, wood white; latex white. *Twigs* densely covered with dark reddish-brown peltate scales which have a fimbriate margin. *Leaves* 45 cm long and 38 cm wide; petiole 7 cm, the petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (7–)9–13(–15), 5–18.5 by 1.5–4.5 cm, acuminate at apex, base cuneate, with peltate scales numerous on the midrib below and scattered elsewhere on the lower leaflet surface; veins 6–15 on each side of midrib; petiolules 5–10 mm. *Inflorescences* in the axils of up to 6 leaves near the shoot apex, c. 13 cm long and 19 cm wide; peduncle up to 1 cm, the peduncles, rachis and branches with numerous to densely covered with scales like those on the twigs. *Flowers* c. 1.5 mm long and 1.5 mm wide; pedicel 0.5–1 mm. *Calyx* densely covered on the outside with peltate scales which have a fimbriate margin. *Petals* 5. *Staminal tube* c. 0.8 mm high, thickened below and between the anthers; anthers 5, usually inserted inside the margin and pointing towards the centre of the flower, sometimes enclosed within the tube. *Infructescence* up to 16 cm long and 8 cm wide, peduncle c. 1 cm, peduncle, rachis and branches densely covered with scales like those on the twigs. *Fruits* 1.5–3 cm long and 2–3.5 cm wide, subglobose, red when ripe; the pericarp thin and brittle when dry, densely covered with scales like those on the twigs on the outside; locules 2 (or 3), each containing one seed. *Seed* c. 1.3 cm long, 1.1 cm wide and 0.9 cm thick, completely covered with a white or yellow aril.

Distribution — *Malesia:* Peninsular Malaysia, Borneo.

Habitat — Found in primary forest on limestone; 100–1000 m altitude.

Note — This species sometimes resembles *Aglaia edulis*, but differs in its indumentum and fruits. It resembles *A. korthalsii*, but the leaflets are usually more numerous, they are paler when dry and the scales are almost confined to the midrib. The fruits are subglobose, with a thin brittle pericarp.

34. Aglaia glabrata Teijsm. & Binn.

Aglaia glabrata Teijsm. & Binn., Nat. Tijds. Ned.-Indië 27 (1864) 42; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 58; Pannell, Kew Bull., Add. Ser. 16 (1992) 177.

Tree up to 20 m. Bole up to 10 m, up to 30 cm in diam., with steep buttresses upwards to 1.2 m. Outer bark greyish-brown or reddish-brown with numerous lenticels, sometimes flaking in irregular scales; inner bark pink or pale yellow; sapwood red or pale yellowish-brown, latex white. *Twigs* densely covered with dark purplish-brown peltate scales which have a fimbriate margin, or sometimes with stellate scales. *Leaves* imparipinnate, up to 22 cm long and 20 cm wide; petiole 3.5–7 cm long, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 5–9, 4–13 by 1.5–5 cm, apex acuminate, cuneate at the slightly asymmetrical base, the upper and lower surfaces sometimes with numerous pits, densely covered with scales like those

on the twigs on the midrib of the lower surface and nearly always absent from the rest of the leaflet surfaces; veins 6–13 on each side of the midrib, reticulation often subprominent on both surfaces; petiolules 3.5–7 mm. *Inflorescence* up to 12 cm long and wide; peduncle 1–2 cm, either with scales like those on the twigs or densely covered with reddish-brown or orange-brown scales on the peduncle, rachis and branches. *Flowers* (not known whether male or female) 1–1.5 mm long and wide, subglobose; pedicels 0.5–1 mm. *Calyx* densely covered with scales like those on the rest of the inflorescence on the outer surface. *Petals* 5. *Staminal tube* c. 1 mm long and wide, obovoid, thickened and adpressed against the ovary below the anthers, the aperture 0.5–0.8 mm in diam. and shallowly lobed; anthers 5, 0.5–0.7 mm long, 0.3–0.5 mm wide, ovoid, inserted below the margin of the tube and protruding to fill or almost fill the aperture. *Infructescence* c. 5 cm long; peduncle c. 1.5 cm; the peduncle, rachis and branches densely covered with scales like those on the inflorescence. *Fruits* c. 1.5 cm long and 1.4 cm wide, subglobose, either densely covered with scales like those on the inflorescence, or with scales which have a dark grey central spot.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Moluccas.

Habitat — Found in primary forest, secondary forest, riverine forest and in kerangas; on granite, sandy loam; 10–800 m altitude; rather common.

Notes — 1. *Aglaia glabrata* is characterized by having dark purplish-brown peltate scales with a fimbriate margin confined to the midrib on the lower surface of the leaflets. The species resembles *Aglaia oligophylla*, but the indumentum of the latter is of stellate hairs, not peltate scales. The distal branches of the inflorescence and infructescence in herbarium specimens of this species are frequently malformed and appear to be galled.

2. *Aglaia glabrata* appears to have been described from a living plant in the Bogor Botanic Garden; no type specimen has been seen. Some of the specimens collected on Bangka Island (from where the cultivated material originated) and labelled *A. glabrata* belong to *A. malaccensis* and others belong to *Dysoxylum arborescens* (Blume) Miq. This may explain why Miquel (1868) included *A. glabrata* in 'species incertae', at the end of his treatment.

35. Aglaia flavescens C.DC.

Aglaia flavescens C.DC., Nova Guinea 8 (1910) 426; Pannell, Kew Bull., Add. Ser. 16 (1992) 179.
Aglaia lauterbachiana Harms, Bot. Jahrb. 72 (1942) 164.

Small tree up to 4 m. *Twigs* greyish-brown, densely covered with shiny orange-brown peltate scales which have a fimbriate margin. *Leaves* 25–56 cm long, 20–50 cm wide; petiole 8–16 cm. *Leaflets* 5–9, 9–25 by 3–11 cm, acuminate at apex, cuneate at the base, with scales like those on the twigs numerous on the midrib below and scattered on the rest of that surface, with numerous minute reddish-brown pits on the upper and lower surfaces; veins 9–20 on each side of the midrib, reticulation visible below; petiolule 0.3–10(–15) mm. Male *inflorescence* 5–6 cm long, 8–12 cm wide, sessile or with a peduncle up to 0.5 cm, the peduncle, rachis and branches densely covered with

scales like those on the twigs, the scales more fimbriate on the distal branches. *Flowers* c. 1 mm long and in diam., subglobose, pedicel 0.5 mm, the pedicel and calyx with few orange-brown peltate scales which have a fimbriate margin. *Petals* 5. *Staminal tube* 0.3–0.4 mm high, 0.4–0.5 mm wide, cup-shaped, sometimes with the margin incurved; anthers 5, c. 0.3 mm long and 0.2 mm wide, ovoid, inserted inside the tube near the margin, protruding and filling the aperture. *Infructescence* c. 4 cm long and 2 cm wide, sessile, the rachis and branches densely covered with scales like those on the twigs. *Fruits* 2 cm in diam., subglobose, densely covered with scales like those on the twigs on the outside, indehiscent, the pericarp thin and brittle when dry; fruitstalks c. 0.3 cm.

Distribution — *Malesia:* New Guinea.

Habitat — No data.

Note — *Aglaia flavescens* is recognized by its shiny orange peltate scales which have a ragged margin and, when dry, its pale yellowish-green leaves. The flowers are small and the fruit has a thin pericarp, which is brittle when dry.

36. Aglaia samoensis A. Gray

Aglaia samoensis A. Gray, U.S. Expl. Exped., Phan. 1 (1854) 236; Pannell, Kew Bull., Add. Ser. 16 (1992) 182, f. 46.

Forest tree up to 7 m. *Twigs* densely covered with dark reddish-brown peltate scales which have a short fimbriate margin and some orange-brown scales which have a longer fimbriate margin interspersed. *Leaves* 19–55 cm long; petiole 4.5–11 cm, the petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (5–) 7–9(–13), 5.5–22(–29) by 2–8 cm, acuminate or almost caudate at the apex, rounded or cuneate at the slightly asymmetrical base, with few to numerous scales like those on the twigs on the midrib and scattered elsewhere and the younger leaflets with numerous pale almost stellate scales on the lower surface, usually glabrescent, but sometimes a few persisting on the older leaves; the lower surface with numerous small dark reddish-brown pits and the same but more faintly on the upper leaflet surface; veins 8–12 on each side of the midrib; petiolules up to 5 mm. *Inflorescence* up to 18 cm long and 22 cm wide; peduncle 0.5–2 cm, peduncle, rachis and branches with scales like those on the twigs, but with a greater portion of those with a longer fimbriate margin. *Flowers* 1–1.5 mm in diam.; pedicel 1–1.5 mm; pedicel and calyx densely covered with fimbriate peltate scales. *Petals* 5 (or 6). *Staminal tube* 0.75–1 mm long, obovoid, with few to numerous simple (occasionally stellate) white hairs on the inside, especially in the upper 2/3 of the tube; anthers c. 0.4 mm long and 0.3 mm wide, inserted inside the margin of the tube and protruding for about half their length, with some simple white hairs. *Infructescence* up to 9.5 cm long and 8 cm wide, peduncle c. 2.5 cm, the peduncle, rachis and branches with indumentum like the inflorescence. *Fruits* 2–3.2 cm long and 1.5–2.5 cm wide, indehiscent, brown, red, orange or yellow, ellipsoid or subglobose when ripe, often asymmetrical when only one seed develops, obovoid when young; the pericarp thin, densely covered with reddish-brown peltate scales which have a fimbriate margin. Locules 2, each containing 0 or 1 *seed* which has a thin translucent aril.

Distribution — Bougainville, Solomon Islands, Santa Cruz Islands, Vanuatu, Wallis Islands, Samoa; *Malesia:* Papua New Guinea (including also New Britain and New Ireland).

Habitat — Found in poorly to usually well-drained primary forest, secondary lowland forest, montane forest and on coral terraces; on limestone and clay; sealevel to 830 m altitude; common.

Uses — Red timber-wood (Bougainville).

Note — *Aglaia samoensis* has an indumentum of dark reddish-brown peltate scales which have a short fimbriate margin, with some orange-brown scales which have a longer fimbriate margin interspersed. These are few to numerous on the midrib on the lower surface of the leaflets and are sparse or absent elsewhere, so that the midrib has a distinctive dark reddish-brown appearance. The lower surface of the leaflets has numerous small dark reddish-brown pits. The staminal tube has few to numerous simple (occasionally stellate) white hairs on the inside, especially in the upper two thirds of the tube.

37. **Aglaia leucoclada** C.DC.

Aglaia leucoclada C.DC., Bull. Herb. Boiss. II, 3 (1903) 172; Pannell, Kew Bull., Add. Ser. 16 (1992) 192.

Small tree up to 5(–25) m tall. Bark smooth light greyish-brown, inner bark pale yellowish brown. *Twigs* densely covered with small reddish-brown peltate scales, sometimes with a fimbriate margin. *Leaves* simple, 10–28 cm long, 2.5–7.5 cm wide, yellowish-green, pale green or pale brown when dry, apex acuminate; cuneate at the slightly asymmetrical base; with a few scales like those on the twigs on the midrib below and scattered on the rest of that surface; veins 10–13 on each side of the midrib; petiole 1.5–3.5 cm, with few to numerous scales like those on the twigs. *Inflorescence* (3–)13–20 cm long, 13–16 cm wide, with few spreading branches, sessile or with a peduncle up to 5 mm, peduncle, rachis and branches with few to numerous peltate scales like those on the twigs and some stellate scales interspersed. *Flowers* 0.8–1.5 mm long, 1.8–0.8 mm wide; pedicel 0.3–0.8 mm, with few to numerous pale brown stellate scales. *Calyx* with few to numerous pale brown stellate scales on the outside. *Petals* 5. *Staminal tube* 0.3–1.5 mm long, 0.7–1 mm wide, cup-shaped and lobed, anthers 5, 0.2–0.4 mm long, c. 0.2 mm wide, ovoid, inserted between the lobes just inside the margin of the tube and pointing towards the centre of the flower. *Infructescence* up to 3 cm, sessile. *Fruits* obovoid, up to 1.8 cm long and 1 cm wide, yellow or orange, the pericarp thin and brittle when dry and with few to densely covered with peltate scales which have a fimbriate margin on the outside; fruitstalks up to 10 mm. Ripe fruit 3.5 cm in diam., subglobose; locules 2, each containing 1 arillate *seed*; aril gelatinous; testa brown.

Distribution — *Malesia:* Papua New Guinea.

Habitat — Found in primary forest, montane forest and in secondary regrowths; understorey tree; 5–870 m altitude.

Note — *Aglaia leucoclada* has simple leaves which are pale green or yellowish-green when dry; the indumentum is inconspicuous and the inflorescence is small and delicate.

Fig. 37. *Aglaia silvestris* (M. Roem.) Merr. a. Leaf and male inflorescence; b. infructescences with young fruits; c. half male flower; d. mature fruits; e. peltate scale (a, e: *Pannell 1321*; b: *Pennington 8006*; c: *Pannell 1906*; d: *Othman et al. S 37548*). Drawing R. Wise.

38. Aglaia silvestris (M. Roem.) Merr.

Aglaia silvestris (M. Roem.) Merr., Interpr. Rumph. (1917) 210; Pannell, Kew Bull., Add. Ser. 16 (1992) 193. — *Lansium silvestre* [Rumph., Herb. Amb. 1 (1741) 153, t. 55] M. Roem., Synops. Monogr. 1 (1846) 99.
Aglaia ganggo Miq., Fl. Ind. Bat., Suppl. 1 (1861) 506; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 47; King, J. As. Soc. Beng. 64, ii (1895) 65; Koord., Atlas 1 (1913) t. 156; Backer & Bakh. f., Fl. Java 2 (1965) 129; Pannell in Tree Fl. Malaya 4 (1989) 216. — *Amoora ganggo* (Miq.) Kurz, J. As. Soc. Beng. 45, ii (1876) 123.
Aglaia pyrrholepis Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 47.
Aglaia forstenii Miq., op. cit. (1868) 46.
Aglaia acuminata Merr., Philipp. J. Sc., Bot. 9 (1915) 531.
Aglaia obliqua C.T. White & Francis, Proc. Roy. Soc. Queensl. 38 (1927) 236.
Aglaia micropora Merr., Univ. Calif. Publ. Bot. 15 (1929) 129.
[*Aglaia copelandii* Elmer, Leafl. Philipp. Bot. 9 (1937) 3286, sine diagn. lat.]
Aglaia cedreloides Harms, Bot. Jahrb. 72 (1942) 164.

Tree up to 30 m (–50 m), with a broad rounded crown. Bole up to 13 m, up to 113 cm in circumference, with up to 7 L-shaped buttresses upwards up to 120 cm and outwards up to 215 cm. Outer bark pale greyish-brown or reddish-brown, longitudinally split at wide intervals, with longitudinal rows of lenticels; inner bark reddish-brown, or dark orange-brown; sapwood paler than inner bark; heartwood pale yellowish-brown, almost white; latex white. *Twigs* slender, densely covered with peltate scales which have a dark brown centre and pale margin. *Leaves* imparipinnate, 19–65 cm long, 14–35 cm wide; petiole 10–20 cm, petiole, rachis and petiolules densely covered with scales like those on twigs. *Leaflets* (5–)13–19, 8–24 by 1.7–6.5 cm, subcoriaceous, usually oblong, sometimes lanceolate or elliptical, acuminate at apex, rounded or shortly cuneate at the sometimes asymmetrical base, with scales like those on the twigs densely covering the upper surface when young but deciduous before maturity and sparse on to densely covering the lower surface; veins 12–21 on each side of the midrib; petiolules 5–10(–20) mm. *Inflorescence* up to 30 cm long and 20 cm wide; peduncle up to 15 cm, peduncle, rachis, branches and pedicels clothed like the twigs. *Flowers* up to 3.5 mm long and 2.5 mm wide; pedicel up to 2 mm long, pedicel and calyx densely covered with scales like those on the twigs. *Petals* 5 (or 6). *Staminal tube* longer than the corolla, obovoid, with a minute pore 0.2–0.3 mm across which is entire at the margin; anthers 5, 1/3 to 1/2 the length of the tube, ovoid, inserted near the base and included in the tube. *Infructescence* up to 30 cm long and 25 cm wide, with c. 50 fruits; the peduncle up to 15 cm, peduncle, rachis, branches and fruitstalks with indumentum like twigs. *Fruits* up to 2 cm long and wide, usually obreniform in outline, flattened, wrinkled when dry, brown, red, orange or yellow, densely covered with scales like those on the twigs, indehiscent, sometimes subglobose (New Guinea); the fruitstalks up to 1 cm. Locules 1 or 2 (or 3), each containing 1 *seed*; aril thin, brown, translucent and sweet. — **Fig. 37.**

Distribution — Andaman and Nicobar Islands, Vietnam, Cambodia, Thailand, Solomon Islands; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, Moluccas, New Guinea, New Britain.

Habitat — Found in primary forest, swamps, savanna, kerengas, monsoon forest, moss forest, along roads, along rivers on clayey loam, sandstone, sand, limestone; sea-level to 2100 m altitude; few and scattered to common.

Uses — Buttresses for house-building (Solomon Islands: San Cristobal); wood used for spear shafts (Philippines: Luzon, Mountain Prov.), axe-handles (Solomons: Guadalcanal), in house construction (Halmahera).

Notes — 1. In western Malesia, the leaves of *Aglaia silvestris* have 13–19 leaflets and when the leaflets are mature, the scales are conspicuous only on the lower surface; the scales are typically bronze in colour, with a paler ragged margin and blackish central spot; the flowers have an obovoid staminal tube with a minute apical pore; the flattened obreniform fruit which has a conspicuously wrinkled surface when dry is peculiar to this species.

In the eastern part of the range, e.g. New Guinea, the fruits are larger (c. 2.5 cm long and 1.7 cm wide) and obovoid rather than small and obreniform, but they often still have the characteristic wrinkled surface when dry. The venation is often reddish, resembling that of *A. perviridis*. The leaflets are more variable in size (including smaller and larger than elsewhere) and may be fewer in number (e.g. 5 or 7), they are still asymmetrical in shape and the asymmetry is sometimes more pronounced. The inside of the staminal tube and the anthers are sometimes hairy. In some specimens, the peltate scales are pale brown, but the asymmetrical leaflets and the minute aperture of the staminal tube distinguish these specimens as *A. silvestris*.

2. *Aglaia samoensis* resembles *A. silvestris*, but the peltate scales of *A. samoensis* lack the very dark centre which is usually found in *A. silvestris* and peltate scales with a long fimbriate margin or stellate scales are more frequent in *A. samoensis*, especially on the inflorescence; the flowers of *A. samoensis* are subglobose and have an obovoid staminal tube with a wide aperture, whereas in *A. silvestris*, the flower is ovoid or ellipsoid and the staminal tube is a similar shape, with a minute aperture.

39. Aglaia perviridis Hiern

Aglaia perviridis Hiern in Hook. f., Fl. Brit. India 1 (1875) 556; Pannell, Kew Bull., Add. Ser. 16 (1992) 198.

Aglaia kingiana Ridley, J. Str. Br. Roy. As. Soc. 82 (1920) 175; Fl. Malay Penins. 1 (1922) 404.

Tree up to 12(–25) m. *Twigs* with numerous to densely covered with small reddish-brown peltate scales which have a dark central spot and an irregular or fimbriate margin, occasionally with stellate scales. *Leaves* up to 54 cm long; peduncle up to 10 cm, petiole, rachis and petiolules with few to numerous scales like those on the twigs. *Leaflets* 11–13, 7.5–23 by 2–6 cm, blackish- or reddish-brown when dry, usually markedly ovate, rounded on one side and cuneate on the other at the markedly asymmetrical base, tapering to a caudate apex; with few to numerous scales like those on the twigs on the midrib below and few on the rest of that surface, usually pitted and sometimes rugulose on both surfaces; veins 12–18 on each side of the midrib, often red when dry, petio-

lule up to 10(–20) mm. *Inflorescence* up to 35 cm long and 24 cm wide; peduncle up to 12 cm, peduncle, rachis and branches with few to numerous scales like those on the twigs, but usually with a fimbriate margin. *Flowers* with few or no scales on the calyx and pedicel. Flower 1.2–2.3 mm long, 1.2–1.8 mm wide, ellipsoid, pedicel 0.5–1 mm, pedicel and calyx without or with occasional hairs or scales. *Petals* 5. *Staminal tube* 1–2 mm long, 0.8–1.8 mm wide, aperture 0.4–1 mm across, the margin shallowly lobed, anthers 5, inserted near the base or about half way up the tube, included or just protruding through the aperture. *Infructescence* up to 26 cm long and 20 cm wide, pendulous; peduncle up to 6 cm, peduncle, rachis and branches with few to numerous scales like those on the twigs. *Fruits* few, up to 3 cm long and 1.7 cm wide, asymmetrically ellipsoid with one side flat or slightly concave, yellow or brown, with a thin brittle pericarp which is densely covered with scales like those on the twigs or paler scales or occasionally reddish-brown stellate scales on the outside, inner surface smooth and shiny; locule 1, containing one seed. *Seed* up to 2.7 cm long and 1.5 cm wide, completely surrounded by an aril, the aril thin, papery and dark reddish-brown when dry and with a network of veins, the shrunken seed within completely separate from the aril and up to 1.6 cm long and 1 cm wide.

Distribution — India, Bangladesh, Bhutan, Andaman Islands, China, Thailand; *Malesia:* Peninsular Malaysia.

Habitat — Evergreen forest, primary forest, secondary forest; on limestone; 100–1330 m altitude; common.

Uses — Timber hard; fruit eaten by the Sakais [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 74].

Notes — 1. *Aglaia perviridis* has 11–13 usually markedly ovate leaflets, the upper and lower surfaces of which are pitted and the midrib and lateral veins are reddish-brown when dry. The fruit is 1-locular and of a characteristic asymmetrically ovoid shape.

2. *Aglaia perviridis* resembles *A. leptantha* and *A. silvestris*. The ovary and fruit of *A. leptantha* have two locules; the pericarp appears to be softer and it dries moulded around the seeds, whereas in *A. perviridis* the dry seed contracts within the pericarp, which is brittle and retains its shape. *Aglaia silvestris* differs from *A. perviridis* in leaflet shape, in having a staminal tube with narrow, entire aperture and in its fruit which is frequently obreniform in shape and has 1, 2 or 3 locules.

40. Aglaia leptantha Miq.

Aglaia leptantha Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 51; Pannell, Kew Bull., Add. Ser. 16 (1992) 201, f. 53.

Aglaia glabriflora Hiern in Hook. f., Fl. Brit. India 1 (1875) 555; King, J. As. Soc. Beng. 64, ii (1895) 63; Ridley, Fl. Malay Penins. 1 (1922) 404; Pannell in Tree Fl. Malaya 4 (1989) 217.

?*Aglaia leptantha* Miq. var. *borneensis* C.DC. in DC., Monogr. Phan. 1 (1878) 604.

Aglaia laevigata Merr., Philipp. Govt. Lab. Bur. Bull. 35 (1906) 31.

Aglaia multiflora Merr., Philipp. J. Sc. 1, Suppl. (1906) 73.

Aglaia glabrifolia Merr., Univ. Calif. Publ. Bot. 15 (1929) 129.

Aglaia gamopetala Merr., Univ. Calif. Publ. Bot. 15 (1929) 126; Pannell in Tree Fl. Malaya 4 (1989) 216.

Fig. 38. *Aglaia leptantha* Miq. Male flowers, the staminal tube extending beyond the petals at anthesis, in some flowers showing the minute, pin-prick aperture. Kuala Lompat, Pahang, Malaysia (*Pannell 1335*). Photograph C.M. Pannell, 1978.

Tree up to 30(–40) m, sometimes flowering and fruiting at 4 m. Bole up to 16 m, up to 132 cm in circumference, fluted near the base or with small buttresses upwards up to 30 cm and root-like buttresses outwards up to 135 cm. Outer bark pale grey, greenish-brown, yellowish-brown, or reddish-brown with greyish-green patches, with longitudinal and transverse cracks and round lenticels; surface of inner bark green and pale yellow; inner bark green, pale orange-brown or reddish-brown; sapwood pale brown, pale yellowish-brown, dark orange-brown or reddish-brown, soft; latex white or exudate pinkish-orange. *Twigs* slender, densely covered with reddish-brown, pale brown or grey peltate scales which have a fimbriate margin, when pale, the scales have a dark grey central spot. *Leaves* imparipinnate, 30–83 cm long, 20–68 cm wide; petiole 6.5–16 cm, petiole, rachis and petiolules with few to densely covered with scales like those on the twigs. *Leaflets* 7–11 (or 12), 3.5–34 by 1.5–14 cm, dark glossy green above, paler beneath, young leaflets brownish-green when dry, older leaflets black or blackish-green when dry, acuminate-caudate at apex, broadly cuneate or rounded to a sometimes subcordate asymmetrical base, lower surface with scales like those on the twigs few to numerous on the midrib, few on the veins and rarely on the surface in between, sometimes in Borneo with numerous orange brown stellate hairs, glabrescent, but the scales present on older parts like those on the twigs, sometimes in Borneo with numerous pits on upper and lower leaflet surfaces; veins 4–14 on each side of the midrib, black or reddish-brown when dry; petiolules 2–10(–25) mm. *Inflorescence* up to 40 cm long and wide; peduncle up to 10 cm, peduncle, rachis and branches with indumentum like the twigs. *Flowers* 1.8–3 mm long, 1.7–3 mm wide, obovoid or ellipsoid, smelling of citronella, pedicels 0.8–2 mm, densely covered with scales like those on the twigs. *Calyx* without or densely covered with scales on the outside. *Petals* 5. *Staminal tube* slightly shorter or longer than the corolla, either with a shallowly 5-lobed aperture c. 0.5 mm in diam. or with a minute apical pore at the apex c. 0.3 mm across, occasionally with a few stellate scales on both surfaces or simple hairs inside; anthers 5, narrowly ovoid, inserted about 1/6–1/3 up the tube and included or just protruding, with a few pale brown stellate scales. *Infructescence* up to 10 cm long and 5 cm wide with few fruits; peduncle up to 6 cm with surface like the twigs and few to numerous hairs or scales like those on the twigs. *Fruits* 1.5–3.2 cm long and 1.5–3 cm wide, ellipsoid or subglobose, sometimes laterally compressed and then c. 2.3 cm thick, with a longitudinal ridge encircling the fruit; the pericarp either thin or hard and woody and up to 5 mm thick, brown, orange, yellow, white or green, densely covered with pale brown stellate scales on the outside; fruitstalks c. 2 mm. Locules 1 or 2, each containing 1 seed. *Seed* up to 2.3 cm long, 1.4 cm wide and 1 cm thick, ovoid, the inner surface flattened; with a complete gelatinous, translucent, sweet-sour edible aril. 2n = 68 [Pannell, Kew Bull., Add. Ser. 16 (1992) 21]. — **Fig. 38.**

Distribution — ?Vietnam (Annam), Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Bunguran Island, Borneo, Philippines, Lesser Sunda Islands (Flores).

Habitat — Found in primary forest, including seasonal swamp, ridge forest, montane forest and in kerangas; on sandstone, limestone, sand, granitic sand, clay and podzolic sand; 20–1700 m altitude; rare to common.

Uses — Timber durable; fruit edible, sour [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 73, 137].

Notes — 1. The leaflets of *Aglaia leptantha* have a caudate, obtuse acumen and are sometimes markedly asymmetrical at the base; the peltate scales are usually pale, with a fimbriate margin and a dark central spot; the secondary venation visible or subprominent.

2. *Aglaia glabriflora* is a form of *A. leptantha* but one which cannot be clearly differentiated from it and is included as conspecific. At Kuala Lompat in Pahang, Peninsular Malaysia, '*A. glabriflora*' is found in closed forest and '*A. gamopetala*' in partially cleared forest where there is more light. At this site they can be distinguished, but appear to be closely allied. *Aglaia gamopetala* has larger leaves, paler indumentum and larger flowers in which the staminal tube extends beyond the corolla and has a minute apical pore; in '*A. glabriflora*', the inflorescence is without scales and the aperture of the staminal tube is wider. However, intermediates between these two are found in other parts of their range.

3. *Aglaia perviridis* is also similar to *A. leptantha*; the differences are described under *A. perviridis*.

41. Aglaia cremea Merr. & L.M. Perry

Aglaia cremea Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 319; Pannell, Kew Bull., Add. Ser. 16 (1992) 206.

Tree 4–13 m high. Bole 7.5–10 cm in diam. Outer bark light brown; inner bark yellow or greenish-yellow, latex white. Sapwood pale yellow; heartwood pinkish-yellow. *Twigs* densely covered with dark reddish-brown peltate scales which have a paler fimbriate margin. *Leaves* 17–40 cm long, 13–30 cm wide, petiole 2.5–6 cm; petiole, rachis and petiolules with numerous scales like those on the twigs. *Leaflets* 5–7(–9), 4.5–15 by 2–5.5 cm, cuneate at base, the apex with a parallel-sided acumen, with few to numerous pale peltate scales like those on the twigs on the lower leaflet surface with paler scales scattered in between; veins 6–8 on each side of the midrib; petiolules 3–5 (–15) mm. *Inflorescence* 2.5–16 cm long, 4–13 cm wide; peduncle, rachis and branches with few pale brown peltate scales which have a fimbriate margin. *Flower* 1.5–2 mm long and wide, pedicels 0.5–1 mm, without or with a few stellate hairs. *Calyx* without or with numerous to densely covered with stellate scales. *Petals* 5. *Staminal tube* 0.5–1 mm long, 1.2–2 mm wide, cup-shaped with the margin incurved, aperture 0.8–1.3 mm across with a lobed margin, anthers inserted just inside the margin or about a third of the way down the tube, protruding and pointing towards the centre of the flower. *Infructescence* c. 6 cm long and 4 cm wide, peduncle c. 1 cm; peduncle, rachis and branches with few pale brown peltate scales which have a fimbriate margin. *Fruits* 1–2.5 cm long, obovoid, brownish-green, densely covered with reddish-brown peltate scales which have a short fimbriate margin; locule 1. *Seed* 1, ?with a thin gelatinous aril.

Distribution — *Malesia:* Papua New Guinea.

Habitat — Found in secondary and in hill forest; 200–1670 m altitude.

Uses — Locally used for tool handles.

Note — *Aglaia cremea* resembles the less robust forms of *A. leptantha*, but it is a

smaller tree and the staminal tube is short and cup-shaped with a wide aperture. This species is found only in Papua New Guinea, where *A. leptantha* does not occur.

42. Aglaia forbesii King

Aglaia forbesii King, J. As. Soc. Beng. 64, ii (1895) 68; Ridley, Fl. Malay Penins. 1 (1922) 406; Pannell in Tree Fl. Malaya 4 (1989) 215; Kew Bull., Add. Ser. 16 (1992) 207, f. 55.
Aglaia humilis King, J. As. Soc. Beng. 64, ii (1895) 69; Ridley, Fl. Malay Penins. 1 (1922) 407; Pannell in Tree Fl. Malaya 4 (1989) 218.

Tree up to 35 m, with a dense rounded crown. Bole up to 60 cm in diam. Outer bark often smooth, brown, pale brown, greenish-brown or greyish-brown, with vertical cracks and lenticels in longitudinal rows, sometimes flaking in irregular scales; inner bark brown, yellowish-brown or reddish-brown; sapwood orange-brown, pale brown, pale yellowish-brown or sometimes reddish-brown; latex white. *Twigs* usually slender, sometimes stout, densely covered with dark brown, reddish-brown or greyish-brown stellate scales or hairs. *Leaves* imparipinnate, up to 100 cm long and 60 cm wide, elliptical in outline, petiole up to 35 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 9–15, 8.5–30 by 2–10 cm, subcoriaceous, green or blackish-green on upper surface, brown or greenish-brown on lower surface when dry, acuminate at apex, rounded or cuneate at the asymmetrical base, upper surface rugulose and pitted, lower surface granular, sometimes rugulose and pitted, with white, pale brown or reddish-brown stellate hairs or scales usually few to numerous on the midrib, few on the lateral veins and scattered on the surface in between, sometimes numerous on the lower surface and deciduous, leaving numerous pits; veins 9–24 on each side of the midrib, midrib and lateral veins often nearly black when dry, the reticulation usually barely visible; petiolules up to 15(–20) mm on lateral leaflets. *Inflorescence* up to 35 cm long and 25 cm wide; peduncle up to 6 cm, peduncle, rachis, branches and petiolules with numerous to densely covered with white, pale brown or reddish-brown stellate scales or hairs. *Flowers* up to 2 mm long; pedicels up to 1.5 mm. *Calyx* densely covered with stellate scales or hairs on the outside. *Petals* 5 or 6. *Staminal tube* shorter than the corolla, up to 1.5 mm long, cup-shaped or subglobose, slightly incurved and shallowly 5-lobed at the apical margin with the aperture up to 1.3 mm wide or with a pin-prick apical pore; anthers 5, 1/3 to nearly the length of the tube, obovoid and just protruding through the aperture. *Infructescence* with c. 20 fruits, up to 35 cm long; peduncle c. 8 cm; peduncle and branches with surface and indumentum like the twigs. *Fruits* up to 4 cm long and 3.8 cm wide, ellipsoid or subglobose, sometimes with a small beak at the apex and sometimes narrowed at the base to a short stipe 3 mm long, sometimes with a longitudinal ridge encircling the fruit; pericarp up to 4 mm thick, soft, fibrous and flexible, white, yellow, orange, grey or greenish-grey, longitudinally wrinkled when dry, densely covered with white or yellowish-grey stellate scales or peltate scales which have a fimbriate margin on the outside, pericarp shiny inside, with white latex. Locules 2, each containing 0 or 1 seed. *Seed* 1.5–3 cm long, 2–2.2 cm wide, c. 1.5 cm thick, with a complete translucent, gelatinous, yellow or pink aril up to 3 mm thick; the aril sweet-sour or with a flavour like that of *Lansium domesticum* Correa.

Distribution — S Burma, S Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo.

Habitat — Found in evergreen, primary, secondary, or moss forest, along rivers, on sand, clay, sandy loam, sandstone, ultrabasic; 30–1000 m altitude.

Notes — 1. The leaflets of *Aglaia forbesii* are sometimes coriaceous, the midrib is prominent and lateral veins are often black or red when dry. The tiny stellate scales scattered on the lower surface are inconspicuous, but stellate hairs are sometimes also present on immature leaves.

2. It is sometimes difficult to separate the leaves from those of *A. leptantha*, but the leaflets of that species are thinner and the secondary venation is visible, all the veins are black (or sometimes red in Borneo) when dry; the leaf apex is obtuse and parallel-sided. *Aglaia leptantha* usually has peltate scales, with a fimbriate margin and a dark central spot.

43. Aglaia foveolata Pannell

Aglaia foveolata Pannell, Kew Bull., Add. Ser. 16 (1992) 211.
Aglaia sp. 7: Pannell in Tree Fl. Malaya 4 (1989) 230.

Tree up to 20(–25) m with a dense feathery crown. Bole up to 2 m in circumference, with buttresses upwards to 75 cm and outwards to 30 cm. Outer bark smooth, reddish-brown or greyish-brown, with shallow longitudinal fissures; inner bark pale brown or reddish-brown; sapwood yellowish-brown; heartwood brown or reddish-brown; latex white. *Twigs* slender, densely covered with reddish-brown stellate hairs or scales near the apex. *Leaves* imparipinnate, up to 42 cm long and 22 cm wide; petiole up to 8 cm, petiole, rachis and petiolules densely covered with stellate hairs or scales like those on the twigs. *Leaflets* (11–)13–17(–27), 5–10.5 by 1.3–2.2 cm, narrowly elliptical, narrowly oblong or lanceolate, acuminate-caudate at apex, usually cuneate at the asymmetrical base but sometimes rounded on one side, with scales or hairs like those on the twigs few or densely covering the midrib on the upper and lower surfaces and absent to numerous on the rest of the leaflet; the upper surface usually shiny and with numerous pits, the lower surface rugulose and often with numerous pits; veins 9–15(–24) on each side of the midrib, reticulation sometimes subprominent or visible on the lower surface; petiolules up to 8 mm. *Inflorescence* up to 22 cm long and wide, ovate in outline; peduncle up to 5 cm long; peduncle, rachis and branches with indumentum like the twigs. *Flowers* up to 1.5 mm in diam.; pedicels up to 1.5 mm, with indumentum like the twigs. *Calyx* with few to densely covered with stellate hairs or scales on the outer surface. *Petals* 5. *Staminal tube* 2/3 as long to nearly as long as the corolla, subglobose, the aperture 0.3–0.5 mm in diam., with a wavy margin; anthers 5, ellipsoid, about 2/3 as long as the staminal tube, inserted near its base or about half way up and usually just protruding. *Infructescence* c. 35 cm long and 20 cm wide; peduncle up to 8 cm, peduncle, rachis and branches with indumentum like the twigs. *Fruits* up to 2.5 cm long, subglobose or broadly ellipsoid, purple, brown, orange or yellow, indehiscent, densely covered with stellate hairs or scales; locules 1 (or 2), each containing one *seed*; aril translucent, sweet.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo.

Habitat — Found in primary forest, secondary forest, swamps, riverine forest and in ridge forest; on sand, silty clay, clay; 6–1000 m altitude.

Note — *Aglaia foveolata* sometimes resembles *A. forbesii*, but it has narrower leaflets and the indumentum is always stellate. It also resembles *A. perviridis*, but the leaves of that species have fewer leaflets which are larger and differ in their venation and indumentum. The leaves of *A. foveolata* resemble those of *A. multinervis*, but in *A. foveolata* the veins are fewer in number and the leaflets are usually pitted on the upper and lower surfaces, the upper surface is shiny when dry, the flowers have 5 petals and 5 anthers; *A. multinervis* has dull leaflet surfaces when dry and its flowers have 3 petals and 6 anthers. The leaves of *A. foveolata* differ from those of *A. multinervis* as described above, but in some specimens, not included in the description above of *A. foveolata*, the number of lateral veins is similar to that in *A. multinervis* and vegetative distinction is based on the indumentum, which is peltate in *A. multinervis* and stellate in *A. foveolata*.

44. Aglaia crassinervia Kurz ex Hiern

Aglaia crassinervia Kurz ex Hiern in Hook. f., Fl. Brit. India 1 (1875) 556; Pannell, Kew Bull., Add. Ser. 16 (1992) 213, f. 58.
Aglaia cinerea King, J. As. Soc. Beng. 64, ii (1895) 66; Ridley, Fl. Malay Penins. 1 (1922) 404.
Chisocheton sumatranus Baker f., J. Bot. Lond. 62, Suppl. (1924) 18.
Aglaia pyricarpa Baker f., op. cit. (1924) 20.
Aglaia sp. 6: Pannell in Tree Fl. Malaya 4 (1989) 229.

Tree up to 22 m, flowering at 6 m. Bole up to 15 m, up to 50 cm in diam.; buttresses upwards up to 2 m, outwards up to 30 cm, up to 20 cm thick. Bark smooth, greyish-brown or greyish-green, lenticellate, sometimes with longitudinal cracks or flaking in small scales; inner bark pale yellow or dark reddish-brown or pink with white latex from cambium region; sapwood yellow, orange or pale brown, sometimes turning purple near the heart; latex white. *Twigs* fairly stout with numerous yellowish-brown or orange brown, peltate scales which are entire or have a fimbriate margin, with white latex. *Leaves* imparipinnate, up to 1 m long and 70 cm wide; petiole up to 20 cm long, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 11–15(–17), 7–35 by 4–12 cm, often greyish-green when dry, acuminate-caudate at the apex, rounded or cuneate at the slightly asymmetrical base, upper surface with numerous almost white scales when young, glabrescent, usually rugulose and with numerous pits and lower surface usually pitted, with numerous scales like those on the twigs on the midrib, veins and surface in between on the lower surface; veins 7–19 on each side of the midrib; petiolules up to 1.5 cm. Male *inflorescence* up to 50 cm long and 60 cm wide. Female inflorescence up to 30 cm long, peduncle, rachis and branches with indumentum like the twigs. *Flowers* subglobose, c. 1.5 mm in diam., fragrant; pedicels up to 1.5 mm. *Calyx* usually densely covered with scales like those on the twigs. *Petals* 5. *Staminal tube* 2/3–3/4 the length of the corolla, subglobose, with a wide aperture 0.4–0.5 mm across, entire; anthers 5, ovoid, 1/2–2/3 length of the staminal tube, inserted 1/3–1/2

the way up the tube and protruding through the aperture. *Infructescence* up to 30 cm long and 20 cm wide, with up to 50 fruits. *Fruits* 5.5–6 cm long and 3.5–4 cm in diam., subglobose or pyriform, dull green, grey, brown or blackish-purple, becoming yellow or orange when ripe; pericarp woody, 1 mm thick, densely covered with scales like those on the twigs on the outside; stalk stout, up to 2 cm long and 1 cm wide. Locules 1 or 2, each containing 0 or 1 seed. *Seed* with aril 2.5–3 cm long, 1.5–1.7 cm wide and 1–1.8 cm thick; aril transparent, reddish-brown, slightly sour.

Distribution — Nicobar Islands, Burma, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines.

Habitat & Ecology — Found in evergreen, primary and secondary forest and in seasonal swamp on acidic rock, over basalt, sandstone, sand, sandy loam, clay; sealevel to 1570 m altitude. The aril is eaten by monkeys.

Note — The leaves of *Aglaia crassinervia* resemble *A. rufinervis*, but there are fewer leaflets and the indumentum is of peltate scales with a fimbriate margin rather than stellate hairs or scales. The length of the fimbriate margin on the peltate scales varies. When the scales have a long fimbriate margin, it is sometimes difficult to distinguish *A. crassinervia* from *A. sexipetala*. That species has numerous stellate scales on the lower leaflet surface and some compact stellate hairs interspersed; the latter are absent in *A. crassinervia*.

45. Aglaia sexipetala Griff.

Aglaia sexipetala Griff., Notul. 4 (1854) 505; Pannell, Kew Bull. 50 (1995) in press.
Aglaia aspera Teijsm. & Binn., Nat. Tijds. Ned.-Indië 27 (1864) 42; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 52; Koord., Atlas (1913) t. 152; C.DC. in DC., Monogr. Phan. 1 (1878) 626; Backer & Bakh. f., Fl. Java 2 (1965) 127; Pannell, Kew Bull., Add. Ser. 16 (1992) 217, f. 60.
Aglaia acuminatissima Teijsm. & Binn., Nat. Tijds. Ned.-Indië 27 (1864) 42.
Aglaia polyphylla Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 56.
Aglaia myristicifolia C.DC., Bull. Herb. Boiss. II, 3 (1903) 176.
Aglaia aspera var. *sumatrana* Baker f., J. Bot. Lond. 62, Suppl. (1924) 20.
[*Aglaia calelanensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 3283, sine diagn. lat.]
Aglaia sp. 5: Pannell in Tree Fl. Malaya 4 (1989) 211.

Tree up to 29 m with ascending branches and a rounded crown. Bole up to 12 m, up to 40 cm in diam., sometimes with L-shaped buttresses upwards up to 1.8 m, outwards up to 2 m and up to 20 cm thick. Bark smooth, greyish-brown, yellowish-brown or reddish-brown with grey, green and pale brown patches, inner bark pink or brown; sapwood yellowish-brown, orange, pinkish-yellow or reddish-brown; latex white. *Twigs* slender, densely covered with reddish-brown stellate scales. *Leaves* imparipinnate, up to 72(–100) cm long and 50(–75) cm wide; petiole up to 17 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 7–13(–17), 7–22(–45) by 1.5–8.5(–15) cm, dark green above and silvery-green or brownish-green below when dry, acuminate at apex, rounded, subcordate or cuneate at the asymmetrical base, with a few stellate scales and numerous pits on the upper leaflet surface and with numerous to densely covered with scales like those on the twigs or peltate scales with a long fimbriate margin on the midrib below, numerous on the rest of the lower surface, interspersed with

brown stellate hairs which have many short arms; veins 7–14(–29) on each side of the midrib; petiolules up to 12(–35) mm. *Male inflorescence* up to 40 cm long and 40(–50) cm wide with indumentum like the twigs; peduncle c. 5 mm. *Flowers* up to 1.5 mm in diam.; pedicels 1–2 mm long. *Calyx* with numerous stellate scales on the outside. *Petals* 5. *Staminal tube* 0.5–1 mm, either shallowly cup-shaped with the apical margin incurved and shallowly 5-lobed or ovoid and with the aperture less than 1 mm in diam.; anthers 5, about half to longer than the length of the tube, inserted near the base or just below the margin of the tube and protruding through the aperture, pointing towards the centre of the flower. *Female inflorescence* little branched, up to 30 cm long and 30 cm wide. Flowers similar to the male but slightly larger. *Infructescence* c. 20 cm long. *Fruits* subglobose or obovoid, up to 5 cm long and 4 cm in diam., yellow, reddishbrown or orange-brown, the pericarp up to 2 mm thick, hard and brittle or woody, densely covered with reddish-brown stellate hairs or scales on the outside, sometimes containing white latex. Locules 2, each containing 1 seed. *Seed* with a complete transparent or white aril.

Distribution — Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines (type of *A. calelanensis* only), New Guinea.

Habitat & Ecology — Found in primary, secondary, kerangas, monsoon forest and along banks on yellow sand, yellow to dark brown loam and silty clay; sealevel to 1600 m altitude; scarce to rather common. Aril eaten by monkeys.

Uses — Aril edible. Timber for house construction (Papua New Guinea: Morobe).

Notes — 1. The leaves of *Aglaia sexipetala* have numerous stellate scales on the lower surfaces of the leaflets, sometimes interspersed with stellate hairs which have numerous short arms. The scales are sometimes peltate with a long fimbriate margin and it may then become difficult to distinguish this species from *A. crassinervia* which has numerous peltate scales with a short fimbriate margin, but in these cases the scales of *A. sexipetala* are interspersed with compact stellate hairs.

2. In the western part of the range, the flower of *A. sexipetala* has a shallow cup-shaped staminal tube, while in New Guinea the staminal tube is ovoid and has a narrower aperture. The absence of records of this species from the Lesser Sunda Islands, Celebes, and the Moluccas suggests that it has a disjunct distribution. Further material, especially of ripe fruits in spirit, may provide characters by which the New Guinea plants may be reliably distinguished from the remaining, western parts of the range, and therefore be recognized as a separate species (*Aglaia myristicifolia*).

46. Aglaia parviflora C.DC.

Aglaia parviflora C.DC., Bull. Herb. Boiss. II, 3 (1903) 176; Pannell, Kew Bull., Add. Ser. 16 (1992) 221, f. 62.
Aglaia forbesiana C.DC., op. cit. (1903) 174.
Aglaia procera C.DC., Denkschr. Akad. Wiss. Math.-Nat. Kl. Wien 89 (1913) 565.
Aglaia acariaeantha Harms, Bot. Jahrb. 72 (1942) 170.

Tree up to 20 m high. Bole up to 16 m, up to 30 cm diam. Outer bark yellowish-brown or pale greyish-brown, with scattered lenticels; inner bark pinkish-brown, sap

wood pale yellowish-brown, becoming pinker inwards; white latex. *Twigs* with numerous orange brown and yellowish-brown peltate scales which have a fimbriate margin. *Leaves* 28–95 cm long, 22–62 cm wide; petiole 5–19(–28) cm long, petiole, rachis and petiolules with numerous to densely covered with scales like those on the twigs. *Leaflets* 5–7(–9), 8–37(–45) by 2.5–13(–21) cm, pale yellowish green or pale green when dry; apex acuminate; usually cuneate or sometimes rounded at the slightly or sometimes markedly asymmetrical base; with numerous to densely covered with scales like those on the twigs and some pale yellow stellate scales on the midrib below, few to numerous mainly stellate scales on the lateral veins and the rest of the lower surface sometimes with numerous pits; veins 7–17(–26) on each side of the midrib; petiolules 5–15(–45) mm long. *Inflorescence* 10–31(–39) cm long, 6–20(–24) cm wide, peduncle 0.5–6 cm, peduncle, rachis and branches with numerous scales like those on the twigs and some stellate scales increasing in frequency distally. *Male flowers* 1–1.5 mm long and wide; pedicel 1.2–2 mm, sometimes with a few stellate scales. *Calyx* with few stellate scales on the outside. *Petals* 5. *Staminal tube* cup-shaped, 0.5–1 mm long with a wide aperture 0.4–0.6 mm across, the margin shallowly lobed and sometimes ciliate; anthers 5, broad, about 1/4 to the same length as the tube, usually inserted just below the margin protruding and pointing towards the centre of the flower, sometimes inserted lower down in the staminal tube and included, usually with simple white hairs on the inside of the tube and on the anthers, sometimes densely clumped and visible in the aperture of the staminal tube; stigma obconical, the apex flattened and the margin raised and lobed. *Female flowers* c. 2.5 mm long and 2 mm wide; aperture of staminal tube c. 0.3 mm in diam.; anthers c. 0.4 mm long and 0.4 mm wide; otherwise like the male flowers. *Fruits* 2–2.5 cm long, 1.5–2 cm wide, obovoid or ellipsoid, dull brown or orange-brown, indehiscent. Pericarp c. 1 mm thick, hard, densely covered with scales like those on the twigs on the outside. Locules 2, each containing 0 or 1 seed. *Seed* with aril c. 1.4 cm long, 1 cm wide and 0.7 cm through; surrounded by a translucent, white, gelatinous aril.

Distribution — Solomon Islands; *Malesia:* Moluccas, New Guinea and New Britain.

Habitat — Found in primary forest, ridge forest, secondary forest, riverine forest, on occasionally flooded plains, along the coast and along rivers; on sand, sandy clay, alluvial, volcanic loam, limestone; sealevel to 1700 m altitude; rather scarce to common.

Uses — Wood is used in house construction (Papua New Guinea: Waskuk).

Notes — 1. *Aglaia parviflora* sometimes resembles *A. sapindina*, but it lacks the dark purplish-brown peltate scales on the midrib on the lower surface of the leaflets. The flower of *A. parviflora* has a subglobose staminal tube, the anthers are hairy, half to three quarters the length of the tube and just protruding; the stigma is obconical, horizontally compressed, with a broad, flattened apex and lobed edge.

2. The indumentum of *A. parviflora* is similar to that of *A. saltatorum* A.C. Smith (Solomon Islands, Vanuatu, Fiji, Wallis Island, Tonga and introduced to Niue Island), but it differs in flower structure. These two species are apparently geographically separated; *A. parviflora* is not recorded from the Santa Cruz Islands, while this is the only part of the Solomon Islands where *A. saltatorum* occurs.

47. Aglaia leucophylla King

Aglaia leucophylla King, J. As. Soc. Beng. 64, ii (1895) 66; Ridley, Fl. Malay Penins. 1 (1922) 403; Pannell in Tree Fl. Malaya 4 (1989) 218; Kew Bull., Add. Ser. 16 (1992) 226.
Aglaia kunstleri King, J. As. Soc. Beng. 64, ii (1895) 69; Airy Shaw, Kew Bull. (1949) 166.
Aglaia heteroclita King, J. As. Soc. Beng. 64, ii (1895) 78; Ridley, Fl. Malay Penins. 1 (1922) 410.
?*Aglaia pallida* Merr., Philipp. J. Sc., Bot. 3 (1908) 147.
Aglaia mirandae Merr., Philipp. J. Sc., Bot. 13 (1918) 295.
[*Aglaia agusanensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 374, pro syn.; Elmer, Leafl. Philipp. Bot. 9 (1937) 3275, sine diagn. lat.]
Aglaia elmeri Merr., Univ. Calif. Publ. Bot. 15 (1929) 127.
Aglaia simplex Merr., op. cit. (1929) 128.
Aglaia insignis Schwartz, Mitt. Inst. Bot. Hamburg 7 (1931) 235.

Tree up to 20 m, sometimes flowering when 1.5 m high. Bole up to 65 cm in circumference; sometimes fluted at base. Outer bark smooth, grey, brown or greyish-brown; inner bark pale yellow; sapwood reddish-brown or white; latex white. *Twigs* densely covered with golden-brown or brown stellate scales usually only near the apex. *Leaves* imparipinnate, up to 80 cm long and 50 cm wide; petiole up to 22 cm, petiole, rachis and petiolules with few to densely covered with scales like those on the twigs. *Leaflets* 9–15(–17), 9–28 by 3.5–11.5 cm, pale green or yellowish-green when dry, with numerous orange-brown pits on the lower leaflet surface and few to numerous tiny golden-brown stellate scales on lower surface, sometimes with darker peltate scales or reddish-brown stellate hairs interspersed, often rugulose on upper and lower surfaces, acuminate or caudate at apex, rounded or cuneate at the asymmetrical base; veins 8–14 on each side of the midrib, reticulation usually visible on lower surface, petiolules 1–20 mm long. *Male inflorescence* up to 60 cm long and 25 cm wide; peduncle up to 15 cm, peduncle, rachis, branches and petiolules with few to numerous golden-brown stellate scales. *Male flowers* up to 1.5 mm in diam.; pedicels up to 1 mm. *Calyx* with few to densely covered with golden-brown stellate hairs on the outside. *Petals* 5. *Staminal tube* up to 0.9 mm long, shorter than the corolla, usually subglobose sometimes obovoid, the aperture c. 0.3 mm across and shallowly 5-lobed; anthers 5(–7), half to as long as the tube, broadly ovoid, inserted near the base or in the upper half of the tube, curved and just protruding through the aperture, with a few simple hairs which sometimes fill the aperture. *Female inflorescence* c. 8 cm long and 2.5 cm wide, with lanceolate bracts up to 9 mm long and 2 mm wide, with few branches and c. 200 flowers; peduncle 3–20 mm. *Female flower* up to 3 mm long and wide; pedicel c. 0.5 mm. *Petals* 5. *Staminal tube* up to 2 mm long and wide, depressed globose or obovoid, with a few hairs inside; aperture c. 0.5 mm; anthers 7, c. 0.7 mm long and 0.5 mm wide with pale margins and tufts of hairs at the apices, inserted near the apex of the tube and protruding. *Infructescence* up to 20 cm long and 18 cm wide with 3–10 fruits; peduncle up to 5 cm, peduncle, branches and fruitstalks with surface and indumentum like the twigs. *Fruits* up to 4.5 cm in diam., usually pyriform, sometimes subglobose, sometimes with a beak and narrowed at the base to a stipe c. 5 mm long, usually with a thick, hard, woody pericarp, sometimes the pericarp thin and brittle, yellow or brown, densely covered with

golden brown or pale brown stellate hairs or scales. Locules 2, each containing 1 seed. *Seed* c. 2.3 cm long and 1 cm wide; aril white or red, edible, sweet or sour; testa brown.

Distribution — S Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines, Celebes.

Habitat — Found in primary, including riverine forest, moss forest, but usually in secondary forest; on sand, limestone, sandy clay, loam, and alluvial; sealevel to 1300 m altitude.

Uses — Boles are used for house-poles (Borneo: Tumbang Tubus).

Notes — 1. The leaflets of *Aglaia leucophylla* are pale green or yellowish-green when dry. The small stellate scales on the lower surface are often deciduous, leaving minute pits where they were attached.

2. *Aglaia leucophylla* resembles *A. edulis*, but is distinguished from it by the more numerous scales on the lower leaflet surface and the pear-shaped fruits. *Aglaia edulis* has a subglobose, 3-locular fruit, although sometimes only one seed develops. The fruit of *A. leucophylla* is occasionally subglobose in, for example, the Philippines, with 2 locules, each of which contains one seed.

48. Aglaia edulis (Roxb.) Wall.

Aglaia edulis (Roxb.) Wall., Calc. Gard. Rep. (1840) 26; Hiern in Hook. f., Fl. Brit. India 1 (1875) 556; Pannell, Kew Bull., Add. Ser. 16 (1992) 229. — *Milnea edulis* Roxb., [Hort. Beng. (1814) 18, nom. nud.] Fl. Ind., ed. Carey & Wall., 2 (1824) 430; Fl. Ind., ed. Carey, 1 (1832) 637.

Aglaia sulingi Blume, Bijdr. (1825) 170; Hassk., Cat. Hort. Bogor. (1844) 220; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 44; Backer & Bakh. f., Fl. Java 2 (1965) 128. — *Milnea sulingi* (Blume) Teijsm. & Binn., Cat. Hort. Bogor. (1866) 211.

Aglaia latifolia Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 42; Koord., Atlas 1 (1913) t. 158, but fruit drawn dehisced; Backer & Bakh. f., Fl. Java 2 (1965) 129.

Aglaia mucronulata C.DC. in DC., Monogr. Phan. 1 (1878) 601.

?*Aglaia latifolia* Miq. var. *teysmannii* Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 140.

Aglaia acida Koord. & Valeton, op. cit. (1896) 143; Backer & Bakh. f., Fl. Java 2 (1965) 128.

Aglaia minahassae Koord., Minah. (1898) 382, 635.

Aglaia curranii Merr., Philipp. J. Sc., Bot. 7 (1912) 276.

Aglaia diffusa Merr., op. cit. (1912) 277.

Aglaia magnifoliola C.DC., Meded. Rijksherb. Leiden 22 (1914) 9.

Aglaia samarensis Merr., Philipp. J. Sc., Bot. 11 (1916) 186.

Aglaia motleyana Stapf ex Ridley, Kew Bull. (1930) 368.

Tree up to 20 m, sometimes flowering at 4 m. Bole up to 50 cm diam.; buttresses upwards up to 1.5 m, outwards up to 50 cm and up to 15 cm thick. Outer bark reddish-brown, yellowish-brown or greyish-green, flaking to expose orange-brown bark beneath; inner bark pink or brown; sapwood pale brown, red or yellow; latex white. *Twigs* densely covered with reddish-brown, pale brown or orange brown stellate hairs and scales or peltate scales which have an irregular or fimbriate margin. *Leaves* up to 44 cm long and 40 cm wide; petiole 3.5–9 cm, petiole, rachis and petiolules with few to densely covered with hairs or scales like those on the twigs. *Leaflets* 5–9(–11), (4–)5.5–23 by (1.8–)2–9 cm, often pale brown or yellowish-brown when dry, often coriaceous, acuminate at apex, rounded or cuneate at the slightly asymmetrical base, with few

to numerous hairs or scales like those on the twigs on the midrib below and occasional on the rest of that surface, often with numerous reddish-brown pits on the upper and lower surfaces; veins 5–16 on each side of the midrib, reticulation subprominent or visible below, petiolules 5–12(–20) mm on lateral leaflets. *Inflorescences* usually in the axils of the leaves, sometimes borne on the older wood of twigs. *Male inflorescence* up to 38 cm long and 32 cm wide, peduncle 0.5–5 cm, peduncle, rachis and branches with numerous to densely covered with hairs or scales like those on the twigs. *Male flowers* 1–1.5 mm long, 1–1.8 mm wide, pedicels 0.5–1.5 mm, densely covered with pale brown or reddish-brown stellate scales or orange brown peltate scales. *Calyx* with few to densely covered with scales like those on the pedicels. *Petals* (4 or) 5. *Staminal tube* cup-shaped, 0.5–1 mm long, up to 1.3 mm wide, thickened inside below the insertion of the anthers, aperture 0.6–1 mm, margin lobed; anthers 5 (6), 0.4–0.5 mm long, 0.2–0.5 mm wide, ovoid, inserted half way down the tube, either included and visible or protruding through aperture, sometimes dehiscent in the lower half only. *Female inflorescence* c. 5 cm long and 4 cm wide; peduncle up to 2.5 cm. *Female flowers* c. 2 mm long and 2.2 mm wide, pedicels nearly 2 mm. *Petals* 5(–7). *Staminal tube* 1 mm long, cup-shaped, aperture c. 1 mm, anthers 5, c. 0.5 mm long and 0.4 mm wide, included or protruding from the aperture of the staminal tube; otherwise like the male. *Infructescence* 7–12 cm long and 7–10 cm wide; peduncle up to 2.5 cm, peduncle, rachis and branches with few to numerous hairs or scales like those on the inflorescence. *Fruits* up to 3.2 cm long and 3.8 cm in diam., subglobose with a central depression at the apex, grey or greenish-brown when unripe, dull orange or brown or yellow when ripe; pericarp 3–6 mm thick, woody or granular, often with numerous warts, with numerous to densely covered with small pale brown or nearly white peltate scales which have a fimbriate margin, pale brown on the outside and rugulose inside, sometimes with white latex. Locules 3, each containing 0–1 seed. *Seed* pale brown with a complete, thick, sour, juicy, translucent, white or orange-brown edible aril, up to 2 mm thick; seed without aril 14–20 mm long, 10–19 mm wide and 5–9 mm through, with the main vascular bundle running through the raphe and antiraphe, divaricately branching from the raphe over the sides of the seed; cotyledons subequal, obliquely transverse.

Distribution — India, Bhutan, Nicobar Islands, Burma, China, Vietnam, Cambodia, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, Lesser Sunda Islands (Bali, Lombok), Moluccas.

Habitat — Found in primary forest, along rocky seashore, on coral and in belukar on sandy loam with clay, sandstone, coral. Rare to scattered; sealevel to 1670 m altitude.

Uses — Fruit (aril) edible [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 76]. Pericarp taken against diarrhoea. In China the wood is said to be red, light in weight and used in making cargo boat boards.

Notes — 1. *Aglaia edulis* is the only species in section *Aglaia* which nearly always has a 3-locular ovary. The fruit is up to 3.5 cm in diameter, subglobose, with a thick pericarp, and a seed which has a thick white edible aril in each of the three locules. However, some specimens have one large seed and a thin, brittle pericarp. Similar variation in fruit occurs in several other species in section *Aglaia* (e.g. *A. korthalsii* and *A.*

Fig. 39. *Aglaia macrostigma* King. Shoot bearing pear-shaped fruits. Ulu Gombak, Selangor, Malaysia (*Pannell 1017*). Photograph C.M. Pannell, 1978.

elliptica) and in *A. lawii* in section *Amoora*. The taxonomic status of the variants requires further investigation.

2. In Java, the distinction between this species and another variable species, *A. lawii*, which belongs to section *Amoora*, is not always clear. The main area of confusion is in '*A. latifolia*'. From the flower structure, Miquel's plant appears to belong to *A. edulis*; '*A. latifolia* var. *teysmannii*' is similar to the type variety in indumentum, but it also closely resembles *A. lawii* from Java. Both *A. edulis* and *A. lawii* have 3-locular fruits in Java, the main difference lying in whether or not they dehisce and in the type of aril, neither of which can be seen in herbarium specimens of '*A. latifolia* var. *teysmannii*'. The fruit in the illustration of '*A. latifolia*' in Koorders, Atlas, based on *Koorders 4693* and *4735*, is shown as just dehiscent; this could represent either the fruit of *A. lawii*, which dehisces on the tree or the fruit of *A. edulis* , with three longitudinal ridges on the pericarp where the ripe fruit probably splits when it is over-ripe or if pressure is applied to the pericarp.

The resolution and full description of this complex, and the determination of the taxonomic status of the synonyms included here, would best be achieved by careful study, documentation and collection of local variants in the field throughout its range and especially of surviving populations in India and Java. It is particularly important that male and female flowers and ripe fruits are collected from each population whenever possible.

49. Aglaia macrostigma King

Aglaia macrostigma King, J. As. Soc. Beng. 64, ii (1895) 78; Ridley, Fl. Malay Penins. 1 (1922) 410; Pannell in Tree Fl. Malaya 4 (1989) 219; Kew Bull., Add. Ser. 16 (1992) 236.

Tree up to 25 m. Bole up to 125 cm in circumference. Bark smooth brown or grey; inner bark pink or red and fibrous; sapwood pink or pale pink; latex white. *Twigs* stout, densely covered with brown or orange-brown peltate or stellate scales. *Leaves* imparipinnate, up to 40 cm long; petiole up to 15 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 3–9, 7.5–25 by 4–10 cm, often slightly bluish-green above and orange-brown below when dry, acuminate at apex, rounded or cuneate at base, with few to numerous peltate or stellate scales on the midrib and lateral veins; veins 8–22 on each side of the midrib; petiolules up to 10(–35) mm. *Inflorescence* axillary or ramiflorous, up to 20 cm long and 15 cm wide; peduncle up to 1.5 cm, peduncle, rachis, branches and pedicels densely covered with stellate hairs or scales. *Flowers* c. 2.5 mm long; pedicels up to 1 mm. *Calyx* densely covered with stellate scales on the outside. *Petals* 5. *Staminal tube* shorter than the corolla, subglobose, with a wide entire aperture; anthers 5, about half the length of the staminal tube, ovoid, inserted just above the centre and curved with the tube with the apices just protruding through the aperture. *Infructescence* axillary or ramiflorous, up to 40 cm long with up to 25 fruits; peduncle up to 9 cm, peduncle, branches and pedicels stout with surface and indumentum like the twigs. *Fruits* up to 4.5 cm long and 3 cm wide, pyriform, yellow or brown; densely covered with orange-brown stellate hairs with numerous short arms; fruitstalks up to 1.5 cm. Locule 1, containing 1 *seed*. — **Fig. 39.**

Distribution — *Malesia:* Peninsular Malaysia.

Habitat — Found in primary forest; 160–1000 m altitude.

Notes — 1. *Aglaia macrostigma* resembles *A. forbesii*, but the leaves of *A. macrostigma* have 3–9 leaflets and those of *A. forbesii* 9–15; the leaflets of *A. macrostigma* are usually bluish-green above and orange-brown below when dry and the tiny peltate or stellate scales are inconspicuous. The inflorescences are often ramiflorous and the fruits are pyriform while in *A. forbesii* the inflorescences are axillary and the fruits subglobose or ellipsoid.

2. The indumentum of *A. macrostigma* resembles that of *A. edulis*, but the fruit of the latter is subglobose.

50. Aglaia odoratissima Blume

Aglaia odoratissima Blume, Bijdr. (1825) 171; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 43; King, J. As. Soc. Beng. 64, ii (1895) 67; Koord., Atlas 1 (1913) t. 160; Ridley, Fl. Malay Penins. 1 (1922) 404; Corner, Wayside Trees 1 (1940) 457; ed. 3, 2 (1988) 496; Backer & Bakh. f., Fl. Java 2 (1965) 128; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131; Pannell in Tree Fl. Malaya 4 (1989) 221; Kew Bull., Add. Ser. 16 (1992) 237.

Aglaia diepenhorstii Miq., Fl. Ind. Bat., Suppl. 1 (1861) 507; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 43.

[*Milnea blumei* Teijsm. & Binn., Cat. Hort. Bogor. (1866) 211, nom. nud.]

Aglaia odoratissima Blume var. *parvifolia* Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 150.

Aglaia odoratissima Blume var. *pauciflora* Koord. & Valeton, l.c.

Aglaia luzoniensis (Vidal) Merr. & Rolfe var. *trifoliata* Merr. & Rolfe, Philipp. J. Sc., Bot. 3 (1908) 105.

Aglaia affinis Merr., Philipp. J. Sc., Bot. 3 (1908) 235.

Aglaia heterophylla Merr., Philipp. J. Sc., Bot. 13 (1918) 77.

Aglaia odoratissima Blume var. *forbesii* Baker f., J. Bot. Lond. 62, Suppl. (1924) 19.

Aglaia cuspidella Ridley, Kew Bull. (1930) 367.

Aglaia fraseri Ridley, Kew Bull. (1930) 368.

Small tree up to 12(–20) m. Bole up to 5 m, up to 25 cm in circumference. Bark smooth, greenish-grey to brown, with small lenticels in longitudinal rows; inner bark green or magenta; sapwood pale pink or pale yellowish-brown or dark reddish-brown; occasionally with some white latex. *Branches* few, long, much divaricate, patent or ascending-patent, with the ultimate branches horizontal in one plane. Twigs slender, densely covered with peltate scales and usually with pale yellowish-brown stellate hairs interspersed, the scales dark brown, some with a marked fimbriate margin, others much less so. *Leaves* few on each twig, imparipinnate, 10–30 cm long, 5–30 cm wide; petiole 1.5–6.5 cm, greenish brown, petiole, rachis and petiolules densely covered with scales and stellate hairs similar to those on twigs. *Leaflets* (1–)3–5(–7), 4.5–18(–23.5) by 2–6(–8.5) cm, bluish-green above and pale brown below when dry, acuminate-caudate at apex with the obtuse acumen often narrow and parallel-sided and up to 20 mm long, rounded or cuneate at the usually asymmetrical base, with scales or hairs like those on the twigs occasional on midrib of upper surface, numerous on midrib of lower surface and scattered on the rest of that surface (occasionally numerous, especially in Borneo); veins 5–9(–11) on each side of the midrib, petiolules up to 20(–35) mm. *Male inflorescence* 7–35 cm long, 2–25 cm wide, peduncle 0–20 mm; rachis, branches and pedicels with numerous reddish-brown stellate scales. *Male flowers* up to 1.5 mm in

diam.; pedicels c. 1 mm. *Calyx* with numerous reddish-brown stellate scales on the outer surface. *Petals* 5. *Staminal tube* less than half the length of the corolla, shallowly cup-shaped with the apical margin incurved and shallowly 5-lobed; anthers c. 0.2 mm long and wide, ovoid, inserted just below and protruding through the aperture of the tube, pointing towards the centre of the flower. *Female inflorescence* a narrow spike-like raceme 3.5–12 cm long with up to 20 brownish-yellow flowers. *Female flowers* up to 2 mm in diam., obovoid, like the male in structure but slightly larger. *Infructescence* up to 20 cm long and 15 cm wide. *Fruits* 1.5–2 cm long, 1–1.5 cm in diam., ellipsoid or obovoid, rounded at apex and tapering at base, yellow, orange or orange-red, densely covered with pinkish-orange stellate scales turning brown when dry; pericarp 1–1.5 mm thick, fibrous and flexible, the innermost layer a detachable membrane which surrounds the seed. Locule(s) 1 (or 2), containing 1 seed. *Seed* c. 1.3 cm long, 0.9 cm wide and 0.8 cm through; aril ± completely covering the seed, pale pink, translucent, gelatinous, sweet-tasting, attached along the raphe; seed coat thin, hard, dark brown; main vascular bundle running through the raphe and antiraphe, divaricately branching from the raphe over the sides of the seed. 2n = 84 [Pannell, l.c. (1992) 21].

Distribution — Nicobar Islands, Burma, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, ?Lesser Sunda Islands.

Habitat — Found in primary, including riverine forest, secondary forest and periodically inundated swamp forest, along road-sides; on limestone, sandstone, metamorphic rock, alluvial, granitic sand, coral, clay, loam, basalt; sealevel to 1870 m altitude; common.

Uses — Timber hard and fairly durable [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 75].

Note — *Aglaia odoratissima* is usually a small tree with slender, more or less horizontal branches. The leaflet indumentum is inconspicuous, but the peltate scales interspersed with stellate hairs which occur along the midrib may be seen with a lens. The presence of peltate scales distinguishes this species from *A. elliptica*.

51. Aglaia luzoniensis (Vidal) Merr. & Rolfe

Aglaia luzoniensis (Vidal) Merr. & Rolfe, Philipp. J. Sc., Bot. 3 (1908) 105; Pannell, Kew Bull., Add. Ser. 16 (1992) 242. — *Beddomea luzoniensis* Vidal, Rev. Pl. Vasc. Filip. (1886) 84.
Aglaia unifoliolata Koord., Minah. (1898) 383, 635.
Aglaia monophylla Perkins, Fragm. Fl. Philipp. (1904) 33.
Aglaia brevipetiolata Merr., Philipp. J. Sc., Bot. 11 (1916) 14.
Aglaia rizalensis Merr., Philipp. J. Sc., Bot. 13 (1918) 289.

Tree up to 10 m, up to 15 cm in diam. Outer bark smooth or lenticellate, brown or red, soft; inner bark red or reddish-brown, soft; cambium pink; sapwood pale brown, white or reddish-brown. *Twigs* densely covered with orange brown or reddish-brown peltate scales which sometimes have a fimbriate margin. *Leaves* simple, 5–23 cm long, 2–6.5(–8) cm wide, brown or greenish-brown when dry; apex acuminate, base cuneate, with numerous scales like those on the twigs on the midrib below and scattered or numerous on the rest of that surface and sometimes with paler brown scales in between;

veins 5–18 on each side of the midrib; petioles 1–3 cm. *Male inflorescence* up to 19 cm long and 9 cm wide; peduncle 3–7 mm, peduncle, rachis and branches densely covered with scales like those on the twigs. *Male flowers* 1–1.5 mm long and wide, pedicel 0.3–1 mm, the pedicel and subtending branchlet densely covered with peltate scales which have a fimbriate margin. *Calyx* densely covered with scales like those on the twigs on the outside. *Petals* 5 (or 6). *Staminal tube* 0.5–0.6 mm high, 1 mm wide, cup-shaped with the margin incurved, thickened below the anthers; anthers 5, 0.2–0.3 mm long and wide, pointing towards the centre of the flower. *Female inflorescence* either c. 2.5 cm long and 1 cm wide with few branches or c. 8 cm long and 4 cm wide and more branched; peduncle 1–6 mm. *Female flowers* sometimes with peltate or stellate scales on the outside of petals; *staminal tube* 0.5–1 mm high and c. 1 mm wide, the anthers c. 0.5 mm long and wide; otherwise like the male. *Infructescence* 5–11 cm long, 4–5.5 cm wide, with c. 3 fruits. *Fruits* c. 1.8 cm long and 1.5 cm wide, dark brown, reddish-brown, pale orange or yellow, densely covered with scales like those on the twigs on the outside, indehiscent; locules 1 or 2, each containing one arillate seed.

Distribution — *Malesia:* Borneo, Philippines, Celebes.

Habitat — Found in primary forest, secondary forest, near mangrove; on sandstone, sandy alluvial, sand, limestone, clay, volcanic clayey sand; 10–1400 m altitude.

Note — *Aglaia luzoniensis* resembles *A. odoratissima*, but differs in having simple leaves and more numerous peltate scales on the lower leaflet surface.

52. Aglaia yzermannii Boerl. & Koord.

Aglaia yzermannii Boerl. & Koord., Ic. Bogor. (1901) t. 87; Steenis, Rheophytes (1981) 287, t. 31; Pannell in Tree Fl. Malaya 4 (1989) 227; Kew Bull., Add. Ser. 16 (1992) 244, f. 68.

Aglaia salicifolia Ridley, J. Str. Br. Roy. As. Soc. 54 (1910) 32; Fl. Malay Penins. 1 (1922) 403; Corner, Wayside Trees 1 (1940) 457; ed. 3, 2 (1988) 496.

Small tree up to 5 m, with a broad irregular crown. Bark pale brown. Branches from near the base, usually patent and projecting horizontally from the river bank over the water, sometimes ascending. *Twigs* slender, with numerous to densely covered with brown or yellowish-brown stellate scales, especially towards the apex. *Leaves* imparipinnate, 14–27 cm long, 10–27 cm wide; petiole 10–25 mm, petiole, rachis and petiolules with few to numerous scales like those on the twigs. *Leaflets* 3–5, 5–17 by 0.5–2 cm, slightly bluish-green and sometimes becoming brown when dry, linear, linear-lanceolate or narrowly lanceolate, slightly curved, acuminate or caudate at apex, cuneate at the asymmetrical base, glabrous or with a few scales on lower surface, particularly along the midrib; veins 9–15 on each side of the midrib; petiolules 2–7 mm. *Male inflorescence* up to 17 cm long and 12 cm wide; peduncle up to 1 cm, peduncle, rachis, branches and pedicels with numerous to densely covered with scales like those on the twigs. *Male flowers* c. 1.5 mm in diam.; pedicels up to 1.5 mm. *Calyx* densely covered with stellate scales on the outside. *Petals* 5. *Staminal tube* 1/2–1/3 the length of the corolla, cup-shaped with the apical margin slightly incurved and shallowly lobed; anthers 5, about 1/3 the length of the tube, broadly ovate, inserted just below the margin of the tube,

protruding through the aperture and pointing towards the centre of the flower. *Female inflorescence* and flowers similar to those of the male but the inflorescence smaller, flowers fewer, up to 2 mm in diam., pedicels up to 2.5 mm. *Infructescence* up to 15 cm long. *Fruits* up to 2 cm long and wide, orange-brown or orange-red, ellipsoid or subglobose, densely covered with stellate scales like those on the twigs; inner surface of pericarp pink. Locules 1 or 2, each containing 1 *seed*; aril translucent, sweet.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia.

Habitat & Ecology — Rheophyte found in riverine forest on granite; 30–120 m altitude; common.

Uses — The Semang of the neighbourhood of Kuala Lipis pound the leaves in cold water and use the preparation for washing the body after child-birth [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 76]. The arils are edible.

Notes — 1. A rheophyte with leaflets which resemble the leaves of *Salix viminalis* L., hence the name of the synonym *A. salicifolia*. This species grows on river banks with the branches projecting horizontally over the water. It is most easily found by swimming near the bank until the strong citronella perfume emitted by the male flowers is detected. Several trees are usually found growing together, the female often bearing all reproductive stages from flower buds to ripe fruits.

2. *Aglaia yzermannii* is found mainly in the Malay Peninsula where it seems to be restricted to the banks of relatively deep stretches of otherwise stony, fast flowing rivers. There is only one gathering known from Sumatra: the type specimen of *A. yzermannii*.

3. The simple-leaved species, *A. rivularis* is found in Sabah and NE Kalimantan. The leaves of that species are almost identical to the leaflets of *A. yzermannii*, differing only in the presence of scales scattered on the lamina as well as on the midrib. Both species are rheophytes.

53. Aglaia rivularis Merr.

Aglaia rivularis Merr., Univ. Calif. Publ. Bot. 15 (1929) 125; Steenis, Rheophytes (1981) 291, t. 32; Pannell, Kew Bull., Add. Ser. 16 (1992) 247.

Small tree up to 15 m. Bole up to 10 m, up to 50 cm in diam. Branches often projecting horizontally from the river bank over the water. Bark smooth, brown or whitish-brown; inner surface of bark brown; middle bark reddish-brown; inner bark reddish-brown or pale brown, cambium pink or yellowish-brown; sapwood pink or almost white. *Twigs* densely covered with reddish-brown, orange brown or pale brown peltate scales which often have a short fimbriate margin. *Leaves* simple, 6.5–24 by 1–4 cm, lanceolate, tapering to an acuminate apex, tapering to a cuneate base; with numerous or densely covered with scales like those on the twigs on the midrib below, few on the rest of the lower leaflet surface, sometimes numerous when young; veins 10–17, reticulation visible or occasionally subprominent below; petiole 1–2 cm, densely covered with scales like those on the twigs. *Inflorescences* up to 6 in the axils of the leaves of the apical shoots, 12–23 cm long, 6–12 cm wide; peduncle 2.5–4.5 cm, peduncle, rachis and

branches densely covered with scales like those on the twigs, or with a longer fimbriate margin. Male and female *flowers* similar, 1–2 mm long, 1.5–2.5 mm wide; pedicel 0.5–3.5 mm, densely covered with peltate scales which have a fimbriate margin. *Calyx* densely covered with peltate scales on the outside. *Petals* 5 (or 6). *Staminal tube* 1–1.3 mm long, 0.9–1.5 mm wide, thickened inside below the bases of the anthers, aperture 0.5–0.7 mm, margin lobed; anthers 5, c. 0.3 mm long and wide, ovoid, inserted inside the margin of the tube, protruding through the aperture and pointing towards the centre of the flower. *Infructescence* 2–18 cm long, with up to 20 fruits, peduncle 1.5–4 cm, peduncle, rachis and branches slender and flexible, densely covered with scales like those on the twigs. *Fruits* 1.5 cm long, 0.8–1 cm wide, ellipsoid, brown, reddish-brown or yellow; fruit-stalks up to 0.8 cm; pericarp reddish-brown, indehiscent. *Seed* 1, surrounded by an aril.

Distribution — *Malesia:* E Borneo.

Habitat & Ecology — Rheophyte, found along river banks in riverine forest; on sand; 3–500 m altitude.

Uses — Wood is used for fence posts (Borneo: Dusun Labuk). The arils are edible.

Note — *Aglaia rivularis* resembles *A. yzermannii*, except that it has simple leaves.

54. Aglaia brassii Merr. & L.M. Perry

Aglaia brassii Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 325; Pannell, Kew Bull., Add. Ser. 16 (1992) 249.

Tree up to 2–20 m; bole diam. 7–15 cm, sometimes with buttresses upwards up to 1.2 m. Outer bark smooth or scaly, greyish-brown or brown; inner bark pinkish-brown; sapwood white, pinkish-yellow or reddish-brown. *Twigs* densely covered with reddish-brown peltate scales, sometimes with paler stellate scales interspersed, sometimes with stellate hairs at the apex. *Leaves* 8.5–29 cm long, 4.5–29 cm wide; petiole 1–7 cm, petiole, rachis and branches densely covered with peltate and stellate scales like those on the twigs. *Leaflets* (1–)3–7, 4.5–22 by 2–7 cm, acuminate at apex, cuneate at the slightly asymmetrical base, with dark reddish-brown peltate scales and some paler stellate scales interspersed densely covering the midrib below and scattered elsewhere on the lower leaflet surface; veins 6–11 on each side of the midrib, not anastomosing; petiolules up to 10(–40) mm. *Inflorescence* c. 13.5 cm long and 8.5 cm wide; peduncle 1.5–3.5 cm, peduncle, rachis and branches with reddish-brown and pale brown stellate scales and peltate scales which have a fimbriate margin. *Flowers* 2–4 mm long and wide, ellipsoid; pedicel 1–3 mm, pedicel and calyx densely covered with dark or pale brown stellate scales. *Petals* 4, 5 or rarely 6. *Staminal tube* 1.2–3 mm long, 1.5–3 mm wide, obovoid with the aperture 0.2–1 mm across; anthers 5, 1–1.3 mm long, 0.4–0.7 mm wide, ovoid, inserted a quarter up to half the way up the tube, either just protruding or included and visible through the aperture. *Infructescence* either with several fruits, c. 7 cm long and 6.5 cm wide with the peduncle c. 2 cm or the fruits solitary with a peduncle up to 3 cm, the peduncle, rachis and branches with indumentum like the inflorescence. *Fruits* 2–2.8 cm long, 1.3–2.5 cm wide, orange brown or yellow, obovoid or

ellipsoid, densely covered with reddish-brown and pale brown peltate scales which have a fimbriate margin, glabrescent. Locules 2, each containing 1 *seed* which is enclosed in a brown, translucent aril.

Distribution — Bougainville, Solomon Islands, Australia (N Queensland, Mount Lewis Range); *Malesia:* New Guinea.

Habitat — Found in undergrowth of primary and secondary forest; sealevel to 500 m altitude; rather common.

Note — *Aglaia brassii* resembles *A. odoratissima* except that the flowers are usually larger, and the staminal tube is obovoid with a pin-prick aperture rather than cup-shaped. *Aglaia brassii* is confined to E Malesia and Australasia, where *A. odoratissima* does not occur.

55. Aglaia puberulanthera C.DC.

Aglaia puberulanthera C.DC., Nova Guinea, Bot. 8 (1914) 1013; Pannell, Kew Bull., Add. Ser. 16 (1992) 252.

Aglaia simplicifolia Harms in K.Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 386, nom. illeg., non (Bedd.) Harms (1896). — *Aglaia schumanniana* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 176, nom. nov. pro *A. simplicifolia* Harms, syn. nov.

Aglaia rubra Ridley in Hook. f., Ic. Pl. (1916) t. 3052; Trans. Linn. Soc., Bot. 9 (1916) 26.

Small tree up to 3 m. *Twigs* greyish-brown with numerous to densely covered with reddish-brown stellate hairs, interspersed with darker peltate scales. *Leaves* simple, 5.5–27.5 by 1.8–7 cm, elliptical or obovate, or subcordate at the base, apex acuminate, with few to numerous stellate hairs and peltate scales on the midrib; veins 10–40 on each side of the midrib; almost sessile or with a petiole up to 1 cm. *Inflorescence* 4–6.5 cm long, 2.5–4 cm wide; peduncle 5–15 mm, peduncle, rachis and branches densely covered with hairs and scales like those on the twigs. *Flowers* 2.5 mm long, 1.5–2.5 mm wide, pedicel 1–2.5 mm. *Calyx* with dark brown stellate scales on the outside. *Corolla* tube divided to about half way into 5 lobes, or petals 5. *Staminal tube* c. 1.2 mm long and wide, cup-shaped; anthers 5, c. 0.7 mm long, inserted on the margin of the tube, the outer surface of the anther continuous with the outer surface of the tube, densely covered with simple yellow hairs along the margins of the anthers. *Fruits* not seen.

Distribution — *Malesia:* New Guinea.

Habitat — Found as understorey tree in primary forest on clay; 80–750 m altitude.

Notes — 1. *Aglaia puberulanthera* has simple leaves with numerous lateral veins. The deep lobes of the staminal tube are densely covered with simple hairs, resembling those of *A. euryanthera*. There is a wide range in the number of lateral veins; in some specimens, including the type specimens of *A. rubra*, the lateral veins are numerous (17–40) and close together, in others, including the type specimens of *A. puberulanthera*, they are fewer (10–16).

2. Examination of isosyntype material (WRSL) of *Aglaia simplicifolia* Harms (*A. schumanniana*), listed as unplaced by Pannell (1992: 352), shows that this plant belongs here.

56. Aglaia euryanthera Harms

Aglaia euryanthera Harms, Bot. Jahrb. 72 (1942) 171; Pannell, Kew Bull., Add. Ser. 16 (1992) 253, f. 72.

Small tree 6–12 m high, with a narrowly spreading crown; bole up to 30 cm in circumference. Inner bark green; sapwood pale yellow, fibrous, with a strong odour. *Twigs* densely covered with dark reddish-brown or orange brown shiny peltate scales which have an irregular or fimbriate margin and dark centre and margin with a paler band in between. *Leaves* 15–49 cm long, 20–46 cm wide; petiole (3–)4–13 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 1–5(–7), 7–26 by 3–10 cm, often pale green above when dry, cuneate at the base, acuminate at apex, with numerous scales like those on the twigs on the midrib and few on the lateral veins below, with numerous dark reddish-brown peltate scales and usually some paler stellate scales in between, with numerous pits on the rest of that surface, veins 9–25 on each side of the midrib; petiolules 5–10(–25) mm. *Inflorescence* 7–18 cm long and 5–28 cm wide; peduncle 1–3 cm, with scales like those on the twigs. *Flower* 2–4 mm long, 1.5–4 mm wide; pedicels 1–3 mm, pedicel and calyx with few to densely covered with scales like those on the twigs. *Petals* 5 (or 6). *Staminal tube* 1.5–2.5 mm long, 1–2 mm wide, deeply cup-shaped, anthers 5, 0.7–1.2 mm long and 0.5–0.8 mm wide, ovoid, inserted on the margin of the tube, the outer surface of the anther continuous with the outer surface of the tube, densely covered with simple yellow hairs along the margins of the anthers with pale yellow simple or stellate hairs on the lower part of the staminal tube inside. *Infructescence* 3–11 cm long, with 1 or 2 fruits, sessile. *Fruits* 1.3–3.2 cm long, 1.4–2 cm wide, subglobose or narrowly ellipsoid and narrowed to a short stipe c. 5 mm long, orange, orange-brown or yellow densely covered with scales like those on the twigs on the outside; pericarp thin; fruitstalks c. 1 cm. Locules 2 each containing 0–1 seed. *Seed* c. 2.5 cm long, 1 cm wide and 1 cm thick, surrounded by a thin dark translucent aril; testa brown or black.

Distribution — Australia (Queensland: Cape York Peninsula); *Malesia:* New Guinea.

Habitat & Ecology — Found in primary forest, secondary forest, dry monsoon forest, gallery forest, forest on flood-plains, along rivers, along coast on red clay and sandy clay; 5–2100 m altitude; occasional to rather common. Seeds eaten by birds and rats.

Note — *Aglaia euryanthera* is variable in the structure and distribution of the indumentum. The scales are usually mainly large and dark purple, but there may be some pale stellate scales interspersed and these are sometimes numerous on the lower leaflet surface. The leaves are often pale green above when dry. The leaves and leaflet indumentum of *A. euryanthera* resemble those of *A. sapindina*, but the proportion of purple peltate scales on the midrib on the lower surface of the leaflets is usually greater in *A. euryanthera* than in *A. sapindina*, from which it is distinguished by the structure of the staminal tube. *Aglaia sapindina* always has stellate scales on the inflorescence and infructescence whereas *A. euryanthera* has peltate scales.

57. Aglaia polyneura C.DC.

Aglaia polyneura C.DC., Nova Guinea, Bot. 8 (1914) 1015; Pannell, Kew Bull., Add. Ser. 16 (1992) 256.

Tree up to 10 m, shrubby or loosely branched. *Twigs* with numerous to densely covered with dark reddish-brown peltate scales which have a fimbriate margin. *Leaves* 10–40 cm long, 12–42 cm wide; petiole 3–10 cm long, petiole, rachis and petiolules with numerous to densely covered with scales like those on the twigs. *Leaflets* 3–5, 8–26 by 3–8 cm, dark brown when dry; apex acuminate caudate, cuneate or sometimes rounded at the slightly asymmetrical base, with scales like those on the twigs, few to numerous on the midrib and scattered among numerous pale stellate scales or with numerous entire peltate scales on the surface below; veins 10–18 on each side of the midrib; petiolules 2–6(–9) mm. Male *inflorescence* up to 26 cm long and 22 cm wide, peduncle 1–5 cm; the peduncle, rachis and branches with few to numerous reddish-brown peltate scales and stellate hairs. *Flowers* up to 1.7 m long and 2 mm wide, pedicels up to 1.5 mm with occasional stellate scales. *Calyx* with numerous stellate scales on the outside. *Petals* 4 or 5. *Staminal tube* c. 0.7 mm long, cup-shaped, shallowly lobed, with 5 small ovoid anthers, 0.3 mm long, inserted on the margin of the tube and pointing towards the centre of the flower. *Infructescence* up to 6 cm long and wide, sessile or with a peduncle up to 5 mm, peduncle, rachis and branches with numerous peltate and stellate scales like those on the inflorescence. Ripe *fruits* up to 2.5 cm long, 2 cm wide, subglobose, the pericarp soft, yellow, and with numerous stellate scales on the outside. *Seeds* 1–3, 10–12 mm long, 6–7 mm wide and c. 4 mm thick, brown, with a thin gelatinous aril.

Distribution — *Malesia:* New Guinea.

Habitat — Forest; 20–1330 m altitude.

Note — *Aglaia polyneura* resembles *A. sapindina*, but the lateral veins are closer together and the leaves are brown when dry, whereas they are bluish-green or pale green in *A. sapindina*.

58. Aglaia sapindina (F. Muell.) Harms

Aglaia sapindina (F. Muell.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 298; Henty, Bot. Bull. Lae 12 (1980) 100, t. 60; Pannell, Kew Bull., Add. Ser. 16 (1992) 257, f. 74. — *Hearnia sapindina* F. Muell., Fragm. Phyt. Austral. 5 (1865) 55.

Celastrus micrantha Roxb., [Hort. Beng. (1814) 86, nom. nud.] Fl. Ind. 2 (1824) 393; ed. Carey, 1 (1832) 625, non *Aglaia micrantha* Merr. (1905) (= *A. elliptica*).

Aglaiopsis glaucescens Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 58. — *Hearnia glaucescens* (Miq.) C.DC. in DC., Monogr. Phan. 1 (1878) 631.

Hearnia glaucescens (Miq.) C.DC. var. *novaguineensis* C.DC. in DC., Monogr. Phan. 1 (1878) 632. — *Aglaia novaguineensis* (C.DC.) C.DC., Bull. Herb. Boiss. II, 3 (1903) 173.

Hearnia macrophylla C.DC. in DC., Monogr. Phan. 1 (1878) 631.

Aglaia ermischii Warb., Bot. Jahrb. 13 (1891) 345.

Aglaia hartmannii C.DC., Bull. Herb. Boiss. II, 3 (1903) 173.

Aglaia gibbsiae C.DC. in L.S. Gibbs, Phytogeogr. Arfak (1917) 212.

Aglaia roemeri C.DC., Nova Guinea, Bot. 8 (1914) 1015.

Aglaia nudibacca C.DC., Denkschr. Akad. Wiss. Math.-Nat. Kl. Wien 89 (1913) 566.

Aglaia rechingerae C.DC., op.cit. (1913) 565.

Aglaia brevipeduncula C.DC., Nova Guinea, Bot. 8 (1914) 1014.
Aglaia gjellerupii C. DC., l.c. 1014.
Aglaia porulifera C. DC., op.cit. (1914) 1016.
Aglaia miquelii Merr., Philipp. J. Sc., Bot. 11 (1916) 280.
Aglaia schlechteri Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 318.
Aglaia rudolfi Harms, Bot. Jahrb. 72 (1942) 173.
Aglaia hapalantha Harms, op.cit. (1942) 172.
Aglaia clemensiae Merr. & L.M. Perry, J. Arnold Arbor. 29 (1948) 158.

Small tree 4–12(–30) m. Bole up to c. 22 cm in diam. Bark greenish-brown, greyish-brown or reddish-brown, flaking in small scales, with scattered small black lenticels or longitudinal lines of reddish-brown lenticels; middle bark red or white, fibrous; inner bark pink or white, pale brown or white, fibrous; sapwood yellowish-brown, pink or white; either with no exudate or with some white latex. *Twigs* with numerous or densely covered with pale brown or reddish-brown peltate scales which have a fimbriate margin, usually interspersed with very dark purplish-brown or blackish-brown peltate scales. *Leaves* 21–65(–95) cm long, 16–50 cm wide; petiole 6–17.5(–29) cm, petiole, rachis and petiolules with scales like those on the twigs. *Leaflets* (3–)5–9, 7–26(–45) by 5–13.5(–21) cm, pale bluish-green or yellowish-green when dry, apex acuminate, rounded or cuneate at the slightly asymmetrical base; veins 8–20 on each side of the midrib, reticulation just visible, with few to numerous scales like those on the twigs on the midrib and veins and sometimes few on the lower surface, occasionally interspersed with stellate hairs, with few to numerous dark or pale reddish-brown pits on the midrib and lower surface; petiolules (5–)10–15(–100) mm. *Inflorescence* 7–28 cm long, 2–24 cm wide, densely covered with reddish-brown stellate scales; sessile or with a short peduncle up to 5 mm, peduncle, rachis and branches with few to numerous peltate scales like those on the twigs, the distal branches and petiolules densely covered with stellate scales or hairs. *Flowers* 1–3 mm long and wide; pedicels 0.5–1 mm; with numerous reddish-brown stellate scales on the outer surface. *Petals* 5. *Staminal tube* less than half the length of the corolla, shallowly cup-shaped with the apical margin incurved and shallowly 5-lobed; anthers c. 0.2 mm long and wide, ovoid, with a pale margin, inserted just below and protruding through the aperture of the tube, pointing towards the centre of the flower. *Infructescence* 7–15 cm long, 3.5–10 cm wide; sessile or with a short peduncle up to 15 mm. *Fruits* 2–2.5 cm long, 1.5–2 cm in diam., indehiscent, ellipsoid or subglobose, red, yellow or orange, the pericarp thin, soft, with numerous or densely covered with stellate scales, glabrescent. Locules 2, each containing 0 or 1 seed. *Seed* completely surrounded by an orange or yellow, translucent aril; testa brown; cotyledons green.

Distribution — Bougainville, Australia (Northern Territory & Queensland: Cape York Peninsula); *Malesia:* Moluccas, New Guinea.

Habitat & Ecology — Found in riverine forest, secondary forest, swamps, alluvial flats, along the beach and paths, in complex mesophyll vine-forest (Queensland); on limestone, sandy clay with granite; sealevel to 3800 m altitude; common. In Papua New Guinea the twigs are sometimes inhabited by ants.

Uses — Sometimes reaches timber size, but the sawdust may cause dermatitis (Henty, l.c. 1980).

Notes — 1. The leaves of *Aglaia sapindina* have a characteristic mixture of peltate scales (some very dark purplish-brown) and stellate or fimbriate-peltate scales on the midrib below; with dark reddish-brown pits on lower leaflets surface and midrib; sometimes interspersed with these are pale brown stellate scales. The scales on the distal branches of the inflorescence are always reddish-brown and stellate.

2. The separation of *A. sapindina* from non-flowering specimens of *A. euryanthera* may be difficult, but the latter species usually has a greater proportion of very dark purple peltate scales on midrib and peltate scales rather than stellate scales on the inflorescence, infructescence and fruits.

59. Aglaia ceramica (Miq.) Pannell

Aglaia ceramica (Miq.) Pannell, Kew Bull., Add. Ser. 16 (1992) 262. — *Aglaia elliptica* Blume var. *ceramica* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 51.

Small tree up to 3 m, with few branches; stem and *twigs* pale brown, densely covered with orange brown stellate hairs near the apex. *Leaves* up to 80 cm long and 70 cm wide; petiole 6–16 cm, petiole, rachis and branches densely covered with hairs like those on the twigs. *Leaflets* 7–9, 10.5–35 by 5–14.5 cm, often bluish-green below when dry, acuminate at apex, rounded or cuneate at the base; with orange-brown stellate hairs numerous on or densely covering the midrib below, numerous on the lower leaflet surface and interspersed with paler stellate hairs which have fewer arms, glabrescent; veins 8–19 on each side of the midrib; petiolules up to 10(–30) mm. *Male inflorescence* in the axils of existing or fallen leaves, 16–24 cm long, 4–32 cm wide, with few branches. *Male flowers* 1.5 mm long and wide; pedicels 1.5 mm, the pedicel and calyx densely covered with stellate hairs or scales. *Petals* 5. *Staminal tube* 0.7 mm long, cup-shaped, aperture 0.8 mm wide, shallowly lobed; anthers 5, 0.6 mm long and 0.4 mm wide, inserted at the base of the tube. *Female inflorescence* in the axils of fallen leaves, up to 1 cm long, with branches from the base and up to 13 flowers. *Female flowers* 3 mm long, 2.8 mm wide; pedicels 0.5 mm. *Petals* 5. *Staminal tube* 1.5 mm long and wide, cup-shaped with the margin incurved and shallowly lobed, with a few simple white hairs inside; anthers 5, 0.5 mm long, 0.6 mm wide, dark brown with pale margins when dry; otherwise like the male. *Infructescence* c. 2 cm long and 3 cm wide, borne on the stem in the axils of about 6 fallen leaves; the first fruits maturing at the same time as flowers on the more distal inflorescences. *Fruits* c. 1.5 cm long and 0.8 cm wide, yellow, obovoid, densely covered with orange brown peltate scales which have a fimbriate margin and stellate hairs on the outside; inner pericarp white. *Seeds* 3; aril white, edible and rather sweet; testa blackish-green.

Distribution — *Malesia:* Moluccas.

Habitat — Found in primary forest, sometimes on limestone; 200–650 m altitude.

Note — *Aglaia ceramica* resembles *A. sapindina* in the colour of its leaves but differs in indumentum. It resembles *A. tenuicaulis* in size and indumentum but the lower leaflet surface is glabrescent, the inflorescences are much smaller and the infructescences are ramiflorous.

60. Aglaia subminutiflora C.DC.

Aglaia subminutiflora C.DC., Bull. Herb. Boiss. II, 3 (1903) 175; Pannell, Kew Bull., Add. Ser. 16 (1992) 266.
Aglaia chalmersii C.DC., op.cit. (1903) 173.
Aglaia edelfeldtii C.DC., op.cit. (1903) 174.
Aglaia stellipila C.DC., Nova Guinea, Bot. 8 (1910) 425.
Aglaia parvifoliola C.DC., Nova Guinea, Bot. 8 (1914) 1017.
Aglaia exigua Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 321.
Aglaia carrii Harms, Bot. Jahrb. 72 (1942) 163.

Small tree to 6(–15 m). Bole to 1.5 m, branches ascending, bark pale brown. *Twigs* densely covered with dark orange or reddish-brown stellate hairs and scales. *Leaves* 12–35 cm long, 11–34 cm wide; petiole 1–9 cm long, petiole, rachis and petiolules with few to densely covered with hairs and scales like those on the twigs. *Leaflets* 3–11, 2.5–18 by 0.5–5 cm, acuminate or caudate at the apex, cuneate or rounded at the asymmetrical base, with few to densely covered with peltate and stellate scales or hairs on the midrib and few to numerous on lateral veins and few or occasionally numerous on the rest of the surface, sometimes with numerous faint pits on the lower surface; veins 7–12 on each side of the midrib; petiolules 1–10(–16) mm. *Inflorescence* 5.5–17 cm long, to 14 cm wide, peduncle 1–25 cm long, peduncle, rachis and branches densely covered with stellate hairs and scales. *Flowers* 1–2 mm long and wide; subsessile or with a pedicel to 2 mm, the pedicel and calyx densely covered with pale orange-brown stellate hairs or scales. *Corolla* divided almost to the base into 5 obovate lobes. *Staminal tube* 1(–1.2) mm long, c. 1 mm wide, cup-shaped or obovoid, the aperture (0.4–)1 mm across, entire or shallowly lobed, without hairs or with numerous pale yellow simple or stellate hairs inside; anthers 0.3–0.6 mm long, 0.3–0.5 mm wide, glabrous or with a few simple hairs, sometimes with tufts of simple white hairs at the apex, either inserted just inside the margin of the tube, protruding and pointing towards the centre of the flower or inserted about half way up the tube and just protruding, the staminal tube thickened below the anthers. *Infructescence* to 11 cm, peduncle to 6.5 cm, with few to numerous hairs or scales. *Fruits* 1.5–2.5 cm long, 1.2–2.7 cm wide, obovoid, brown, orange or yellow, with few to densely covered with scales on the outside. Locules 2, each containing one *seed*.

Distribution — ?Solomon Islands; *Malesia:* New Guinea, New Ireland.

Habitat — Understorey tree found in sometimes inundated primary forest, secondary forest, riverine forest, *Castanopsis* forest; on sandy clay or basalt; sealevel to 1920 m altitude; frequent.

Note — *Aglaia subminutiflora* and *A. cuspidata* are similar to *A. basiphylla* A. Gray from Fiji. The latter species has a blunt leaflet apex and spreading veins. In all three species, the indumentum may consist of either hairs or scales or a mixture of scales and long-armed hairs.

61. Aglaia subsessilis Pannell

Aglaia subsessilis Pannell, Kew Bull., Add. Ser. 16 (1992) 273.

Tree up to 15 m. Outer bark thin, dark reddish-brown or white with black patches, scaly, with brown lenticels; inner bark reddish-brown or pale yellow, laminated; cambium pale yellow; sapwood pale purple, white or red and white; latex white. *Twigs* with numerous to densely covered with orange-brown stellate hairs. *Leaves* trifoliolate or imparipinnate, up to 21 cm long and 32 cm wide; petiole 3–10(–30) mm, petiole, rachis and petiolules with numerous to densely covered with hairs like those on the twigs. *Leaflets* 3–5, the laterals opposite, differing markedly in size, all pale yellowish-green when dry, with numerous orange-brown pits on the lower surface of the leaflets and the midrib on the lower surface densely covered with orange-brown stellate hairs; the basal pair of leaflets 2.5–8 by 1.5–5 cm, acuminate at the apex, rounded at the base, veins 5–8 on each side of the midrib, petiolules c. 2 mm; the remaining lateral leaflets, if present, 11–18 by 4.5–6.5 cm; the terminal leaflet up to 29 by 13 cm; these lateral and the terminal leaflets caudate at the apex, cuneate or rounded at the asymmetrical base; veins 10–14(–17) on each side of the midrib; petiolules up to 3(–14) mm. *Inflorescence* 21–26 cm long, 15–28 cm wide; peduncle 6–8.5 cm, peduncle, rachis and branches with numerous to densely packed orange-brown stellate hairs. *Flowers* 0.5–1.2 mm long and wide; pedicels c. 0.2–0.8(–2) mm long, pedicels and calyx with a few orange-brown stellate hairs or scales. *Petals* 5. *Staminal tube* up to 0.5 mm high, cup-shaped, the margin shallowly lobed; anthers 5, up to 0.3 mm long and wide, inserted just inside the margin and pointing towards the centre of the flower. *Infructescence* up to 14 cm long; the peduncle up to 8 cm, and the peduncle, rachis and branches with numerous to densely packed hairs like those on the twigs. *Fruits* 1 or 2, c. 6.5 cm long and 2.5 cm wide, red when young, yellow when ripe, narrowly ellipsoid, with a short stipe up to 5 mm long and a beak up to 5 mm long; the pericarp thin and leathery when dry, with 10 longitudinal ridges, along two of which the pericarp splits when dry, densely covered with compact reddish-brown stellate hairs on the outer surface. Locule 1, containing one seed. *Seed* 4–4.2 cm long, 1.2–1.5 cm wide, and 0.6–0.7 mm thick, ellipsoid, flattened on the raphe side, the testa with a conspicuous network of veins.

Distribution — *Malesia:* Borneo (Sarawak and Sabah).

Habitat — Found in primary forest; 430–830 m altitude.

Notes — 1. *Aglaia subsessilis* is unusual in having almost sessile leaves, in which the basal pair of leaflets are small and almost round in shape. *Aglaia basiphylla* and *A. evansensis*, both of which are confined to Fiji, are the only other species of *Aglaia* in which subsessile leaves are found.

2. *Aglaia subsessilis* resembles *A. leucophylla* in the pale yellowish-green colour of the leaflets when dry and *A. elliptica* in its indumentum.

3. The fruit is narrowly ellipsoid and longitudinally ridged, and resembles that of the uncommon Bornean variant of *A. simplicifolia* which was treated as a separate species, *A. sterculioides*, by Kostermans. In both of these the pericarp splits open in herbarium specimens, although whether or not the ripe fruit dehisces should be confirmed in the field.

62. Aglaia elliptica Blume

Aglaia elliptica Blume, Bijdr. (1825) 171; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 50; Koord., Atlas 1 (1913) t. 15; Backer & Bakh. f., Fl. Java 2 (1965) 126; Pannell in Tree Fl. Malaya 4 (1989) 214; Kew Bull., Add. Ser. 16 (1992) 275, f. 82. — *Hearnia elliptica* (Blume) C.DC. in DC., Monogr. Phan. 1 (1878) 628.
Aglaia inaequalis Teijsm. & Binn., Nat. Tijds. Ned.-Indië 2 (1851) 305 ('*inequale*').
Milnea lancifolia Hook. f., Trans. Linn. Soc. 23 (1860) 165. — *Aglaiopsis lancifolia* (Hook. f.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 59. — *Hearnia lancifolia* (Hook. f.) C.DC. in DC., Monogr. Phan. 1 (1878) 630. — *Aglaia lancifolia* (Hook. f.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 298, t. 163 M & N; Steenis, Rheophytes (1981) 289.
Aglaia ovata Teijsm. & Binn., Nat. Tijds. Ned.-Indië 27 (1864) 43.
Milnea dulcis Teijsm. & Binn., Cat. Hort. Bogor. (1866) 211, nomen; Nat. Tijds. Ned.-Indië 29 (1867) 253. — *Aglaia rufa* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 49, nom. superfl.
Aglaia reinwardtii Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 51.
Aglaia rufa Miq. var. *celebica* Miq., op. cit. (1868) 49.
Hearnia villosa C.DC. in DC., Monogr. Phan. 1 (1878) 632. — *Aglaia villosa* (C.DC.) Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 323.
Aglaia menadonensis Koord., Minah. (1898) 381, 635.
Aglaia stapfii Koord., Minah. (1898) 383, 635.
Aglaia oxypetala Valeton, Ic. Bogor. (1901) t. 86.
?*Aglaia harmsiana* Perkins, Notizbl. Bot. Gart. Mus. Berlin 32 (1903) 78.
Aglaia micrantha Merr., Philipp. Govt. Lab. Bur. Bull. 29 (1905) 22.
Aglaia pauciflora Merr., Philipp. Govt. Lab. Bur. Bull. 35 (1906) 31.
Aglaia apoana Merr., Philipp. Govt. Lab. Bur. Bull. 35 (1906) 30.
Aglaia langlassei C.DC., Ann. Conserv. & Jard. Bot. Genève 10 (1907) 151.
Aglaia palawanensis Merr., Philipp. J. Sc., Bot. 3 (1908) 235.
Aglaia trunciflora Merr., Philipp. J. Sc., Bot. 9 (1915) 303.
?*Aglaia lagunensis* Merr., Philipp. J. Sc., Bot. 9 (1915) 537.
Aglaia clementis Merr., Philipp. J. Sc., Bot. 13 (1918) 76.
?*Aglaia moultonii* Merr., Philipp. J. Sc., Bot. 13 (1918) 78.
?*Aglaia robinsonii* Merr., Philipp. J. Sc., Bot. 13 (1918) 291.
Aglaia tayabensis Merr., Philipp. J. Sc., Bot. 13 (1918) 292.
Aglaia baramensis Merr., J. Str. Br. Roy. As. Soc. 86 (1922) 317; Steenis, Rheophytes (1981) 287, t. 30.
[*Aglaia urdanetensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 373, pro syn.; Elmer, Leafl. Philipp. Bot. 9 (1937) 3319, sine diagn. lat.]
Aglaia marginata Craib, Kew Bull. (1926) 343.
Aglaia caulobotrys Quisumb. & Merr., Philipp. J. Sc. 37 (1928) 156.
Aglaia havilandii Ridley, Kew Bull. (1930) 367.
Aglaia tembelingensis M.R. Hend., Gard. Bull. Str. Settl. 7 (1933) 94.
[*Aglaia banahaensis* Elmer ex Merr., l.c., pro syn.; Elmer, op.cit. (1937) 3281, sine diagn. lat.]
[*Aglaia antonii* Elmer, op.cit. (1937) 3278, sine diagn. lat.]
[*Aglaia davaoensis* Elmer, op.cit. (1937) 3289, sine diagn. lat.]
[*Aglaia longipetiolata* Elmer, op.cit. (1937) 3295, sine diagn. lat.]
[*Aglaia querciflorescens* Elmer, op.cit. (1937) 3303, sine diagn. lat.]
[*Aglaia mindanaensis* Merr. ex Elmer, op.cit. (1937) 3306, in syn.]
[*Aglaia negrosensis* Merr. ex Elmer, l.c., in syn.]
[*Aglaia sorsogonensis* Elmer, op.cit. (1937) 3310, sine diagn. lat.]

Tree 2–20(–40) m, with an irregularly rounded crown. Bole up to 15 m, up to 50 cm in diam., sometimes fluted throughout, with L-shaped buttresses upwards up to 150 cm, outwards up to 100 cm and up to 45 cm thick. Bark dark reddish-brown or greenish-brown with shallow pits, inner bark magenta; sapwood pale yellow pinkish-red or dark

reddish-brown; latex white. Branches patent or ascending. *Twigs* densely covered with usually reddish-brown, pale orange brown or yellowish-brown stellate hairs or scales, sometimes with pale brown or reddish-brown peltate scales which have a fimbriate margin. *Leaves* imparipinnate, 15–65 cm long, 12–60 cm wide; petiole 3–10 cm, petiole, rachis and petiolules densely covered with stellate hairs or scales like those on the twigs. *Leaflets* (5–)7–11(–16 in rheophytic form in Borneo), 5–34.5 by 1–11 cm, young leaves yellowish-green turning darker green when mature, usually elliptical (narrowly elliptical in the rheophytic form) or oblanceolate-oblong, rarely oblong, the apex acuminate or acuminate-caudate, cuneate or rounded at the sometimes asymmetrical base, the young leaves densely covered with hairs and stellate scales like those on the twigs on both surfaces, when mature the upper and lower surfaces sometimes pitted, with hairs or stellate scales like those on the twigs numerous on to densely covering the midrib and sometimes the lateral veins below, few on the rest of that surface; veins 6–19 on each side of the midrib; petiolules 4–20(–24) mm. *Male inflorescence* 23–50 cm long, 14–60 cm wide; peduncle 1–10 cm, peduncle, rachis and branches with indumentum like that on the twigs. *Flowers* up to 6,000, 1.2–1.5 mm long, 1–1.6 mm wide; pedicels 0.5–2 mm, with indumentum like the twigs. *Calyx* densely covered with brown stellate scales on the outside. *Petals* 5. *Staminal tube* 0.5–0.75 mm long, 1 mm wide, shallowly cup-shaped, yellow, thickened inside below the insertion of the anthers, the apical margin shallowly or deeply 5-lobed (in the rheophytic form, the staminal tube is divided almost to the base into 5 lobes); anthers c. 0.4 mm long and 0.3 mm wide, yellow when immature, brown at anthesis, turning black later, ovoid, inserted just below the aperture and pointing towards the centre of the flower. *Female inflorescence* 13–37 cm long and 5–14 cm wide, with fewer branches and fewer flowers than in the male; peduncle 2–7 cm. *Flowers* 1.8–2.2 mm long, 2–2.5 mm wide, otherwise similar. *Infructescence* 5.5–30 cm long and 5–15 cm wide with few to 100 or more fruits, when numerous the fruits packed tightly together; peduncle up to 10 cm, peduncle, rachis, branches and fruitstalks with numerous stellate hairs and scales. *Fruits* 1.5–3.5(–5) cm long, 1.5–3 (–5) cm wide, bright pale green when young, orange when mature, obovoid or ellipsoid, indehiscent, with few to densely covered with reddish-brown stellate scales; pericarp 3–10 mm thick, inner surface shiny, orange, white latex present until fruit ripens, opening under pressure loculicidally along a longitudinal ridge encircling the fruit. Locules 2; septum persistent. *Seeds* 1 or 2, 2.2–2.8 cm long, 1–1.4 cm across, ovoid, the inner surface flattened; aril 2–3 mm thick, sometimes not quite complete on the antiraphe side, pinkish-orange, translucent, sweet or acidic tasting; with two layers beneath the aril, the outer hard, chestnut brown, the inner thin and membraneous, with the main vascular bundle running through the raphe and antiraphe, divaricately branching from the raphe over the sides of the seed. 2n = 68 [Pannell, l.c. (1992) 21]. — **Fig. 30c, 31.**

Distribution — Burma, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Celebes, Lesser Sunda Islands (Bali, Flores).

Habitat — Found in swamp forest, secondary and primary forest, river banks, along road, edges of marshes and on periodically inundated land; on granite, clay, limestone, sandstone, sand; sealevel to 2000 m altitude; scattered to locally common.

Uses — Bark boiled and solution bathed in is used against tumours; leaves are applied to wounds (Philippines, Mindanao).

Notes — 1. *Aglaia elliptica* is most frequently found in forest close to rivers and subject to periodic flooding.

2. The leaves of this species sometimes resemble those of *A. odoratissima*, but they usually have more leaflets and the indumentum is of stellate hairs or stellate scales only; the peltate scales are absent on the leaves of *A. elliptica*. The indumentum is usually dense on the midrib of the lower surface of the leaflet. *Aglaia elliptica* is usually a larger tree than *A. odoratissima*. The flowers are similar in structure in the two species, but the inflorescences of *A. elliptica* are larger and the flowers more numerous.

3. The fruit of *A. elliptica* has two locules, one or both of which contain(s) a single seed; a longitudinal ridge nearly always encircles the ripe fruit and it usually has a dense reddish-brown indumentum; the fruit is, however, sometimes small or glabrescent or lacks the longitudinal ridge in the Philippines and Celebes. In these cases, the tree is usually smaller and the indumentum is of pale stellate scales rather than reddish-brown stellate hairs. Similar variants of *A. elliptica* are occasionally found in Peninsular Malaysia and Borneo. Some of the variation in size and conspicuousness of the longitudinal ridge is attributable to different stages in development of the fruit. Glabrescent fruits are also found in the Philippines in several other species, which have a dense indumentum in other parts of their range (e.g. *A. elaeagnoidea*).

4. Some more robust specimens from Celebes and Borneo have stellate scales on the midrib and the fruit has a thick woody pericarp when dry. These are included here because of the characteristic longitudinal ridge on the fruit and because there are no reliable features on which they can be recognized as a separate species or subspecies.

5. A rheophytic form (*A. lancifolia*) occurs only in Borneo. It usually has more numerous, narrower and often smaller leaflets than in the rest of the species and is found along river banks, often overhanging the water. A series of intermediates connects *A. elliptica* and *A. lancifolia*, so the latter is treated as conspecific.

63. Aglaia cinnamomea Baker f.

Aglaia cinnamomea Baker f., J. Bot. Lond. 61, Suppl. (1923) 9; Pannell, Kew Bull. 48 (1993) 244.
Aglaia conferta Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 322; Pannell, Kew Bull., Add. Ser. 16 (1992) 283.

Tree 5–23 m high. Bole 9–30 cm in diam., without buttresses. Outer bark grey brown, smooth, slightly peeling; middle bark pink to dark red; inner bark white to red with white streaks, layered and fibrous, with a pleasant odour; some white latex; sapwood cream to reddish; heartwood reddish-brown to dark red. *Twigs* with pale stellate scales and reddish-brown stellate hairs, which sometimes have long arms. *Leaves* 22–46 cm long, 14–42 cm wide, petiole 6–14 cm. *Leaflets* (9–)11–13(–14), 7–21 by 2.5–6 cm, acuminate at apex, rounded at the base; veins 9–20 on each side of the midrib; petiolules 2–7 mm. *Inflorescence* 33 cm long, 24 cm wide, sparsely branched, peduncle, branches and pedicels densely covered with stellate scales and hairs which have long

arms. *Flowers* 2 mm long, 2.5 mm wide, ± sessile. *Calyx* densely covered with stellate hairs on the outside. *Petals* 5. *Staminal tube* c. 0.8 mm long and wide, aperture c. 0.4 mm across, anthers 1/2–1/3 the length of the tube, with pale orange stellate scales and hairs. *Infructescence* 15–25 cm long, 9–18 cm wide; peduncle 4 cm, the peduncle, branches and pedicels with numerous stellate scales and hairs which have long arms. *Fruits* 5.5 cm long, 4 cm wide, yellow or brown. Pericarp fibrous, 0.5 cm thick, no dehiscence line, pericarp densely covered with peltate scales which have a fimbriate margin on the outside, inner surface shiny; locule 1. *Seed* 1, 2.7–3 cm long, 1.8–2 cm wide, 1.3–2 cm thick; aril thin, red or orange, with numerous veins originating from a wide raphe, almost certainly translucent when fresh.

Distribution — *Malesia:* New Guinea.

Habitat — Found in lowland primary forest and in secondary forest on limestone; 15–1800 m altitude.

Notes — 1. *Aglaia cinnamomea* resembles *A. subminutiflora* in its indumentum of peltate fimbriate and long-armed stellate hairs, but it is more robust; the distinction between these two species is not clear-cut. However, the fruits and infructescences are usually stouter in *A.cinnamomea* (more ripe fruits are needed) and there are usually fewer leaflets in *A. cinnamomea* which tend to be oblong or elliptical in shape.

2. *Aglaia cinnamomea* is like *A. elliptica*, but the aperture of the staminal tube and the fruits are smaller and the pericarp thinner except in the large woody ellipsoid fruits of *NGF 39109* (which are densely covered with pale compact stellate hairs on the outside).

3. *Aglaia cinnamomea* also resembles *A. parksii* A.C. Smith (Bougainville, Solomon Islands and Fiji) in vegetative characters, but differs in its flower structure, and *A. meridionalis* Pannell (endemic to the Cape York Peninsula in Australia), but that species has a trimerous flower.

64. Aglaia aherniana Perkins

Aglaia aherniana Perkins, Fragm. Fl. Philipp. (1904) 32; Pannell, Kew Bull., Add. Ser. 16 (1992) 285.
Aglaia myriantha Merr., Philipp. J. Sc., Bot. 13 (1918) 295.
[*Aglaia irosinensis* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 371, in obs. pro syn.]

Tree. *Twigs* greyish-brown or reddish-brown, with numerous to densely covered with pale brown stellate hairs. *Leaves* c. 41 cm long and 22 cm wide; petiole 13 cm, petiole, rachis and petiolules with numerous to densely covered with hairs like those on the twigs. *Leaflets* 13–23, 3.5–12 by 2–3.4 cm, coriaceous, acuminate at apex, cuneate or rounded at the slightly asymmetrical base, with pale brown stellate hairs numerous to forming a dense cover on the midrib below, numerous on the upper and lower leaflet surfaces when young, glabrescent, with numerous pits on the upper and lower leaflet surfaces; veins 7–12 on each side of the midrib; petiolules to 10(–20) mm. *Inflorescence* 24–45 cm long, 14–26 cm wide; peduncle 5–8 cm, peduncle, rachis and branches with numerous to densely covered with scales like those on the twigs. *Flower* 1–2 mm long, 1–1.5 mm wide, subsessile. *Calyx* densely covered with pale brown stellate hairs on the outside. *Petals* 5. *Staminal tube* 0.7–1.3 mm long, 0.6–1.3 mm wide,

obovoid, narrowed at the base, aperture 0.5–0.7 mm, shallowly lobed; anthers 5, 0.2–0.4 mm long, 0.2–0.3 mm wide, inserted half way up the staminal tube, the tube thickened below the insertion of the anthers. *Infructescence* 22–25 cm long, 12–20 cm wide; peduncle 6–12 cm long. *Fruits* 0.5 cm in diam., subglobose, dark brown when dry, with few stellate scales on the outside.

Distribution — *Malesia:* Philippines.

Habitat — In primary forests at low and medium altitudes.

Note — *Aglaia ahemiana* resembles *A. elliptica*, but has coriaceous leaflets with numerous pits on both surfaces; the fruits are much smaller than in *A. elliptica* and they have no longitudinal ridge.

65. Aglaia barbanthera C.DC.

Aglaia barbanthera C.DC., Nova Guinea, Bot. 8 (1914) 1016; Pannell, Kew Bull., Add. Ser. 16 (1992) 286.

Tree 2–15(–20) m. Bole c. 10 cm in diam. Bark brown; sapwood pale yellow. *Twigs* densely covered with dark reddish-brown peltate scales which have a fimbriate margin and some orange-brown stellate scales interspersed. *Leaves* 9–42 cm long, 7–24 cm wide; petiole 1.5–11 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* (7–)9–11, 3.5–18 by 1.5–6.5 cm, acuminate at apex, usually cuneate, sometimes rounded at the base, veins 8–15 on each side of the midrib, densely covered with scales like those on the twigs on the midrib and occasionally on the veins below, with numerous faint pits on the rest of that surface; petiolules 1–13 mm. Male *inflorescence* 18–22 cm long, 12–16 cm wide; peduncle 3–5 cm; female inflorescence c. 9.5 cm long and 4 cm wide; peduncle 0.5–2 cm, peduncle, rachis and branches in both sexes densely covered with scales like those on the twigs or sometimes with stellate hairs. Male and female *flowers* 1–2 mm long and wide, subglobose; pedicels 0.5–1.2 mm, pedicel and calyx densely covered with dark reddish-brown stellate scales or hairs. *Petals* 5. *Staminal tube* 0.6–1 mm long and wide, cup-shaped or obovoid with a lobed margin; anthers 5, 0.2–0.6 mm long and 0.2–0.5 mm wide, ovoid, with pale yellow margins and either without hairs or scales or densely covered with white or pale brown simple or stellate hairs, scattered on the inside of the tube and sometimes on the outside of the tube or along the margins of the lobes, inserted in the upper half of the tube either protruding and filling the aperture or barely protruding. *Infructescence* 3.5–12 cm long, 4–12 cm wide; peduncle up to 2 cm, peduncle, rachis and branches densely covered with scales like those on the twigs. *Fruits* obovoid, 1.2 cm long and 0.8 cm wide, bright orange or brown, with dense scales.

Distribution — *Malesia:* New Guinea.

Habitat — Found in primary, fagaceous and hill forest; 60–2000 m altitude.

Note — *Aglaia barbanthera* is characterized by its indumentum of dark reddish-brown peltate scales which are often interspersed with paler stellate scales. The dark colour of the dense indumentum on the midrib contrasts with the pale green of the lower surface of the leaflets.

66. Aglaia cumingiana Turcz.

Aglaia cumingiana Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 409 ('*Aglaja*'); Pannell, Kew Bull., Add. Ser. 16 (1992) 291. — *Hearnia cumingiana* (Turcz.) C.DC. in DC., Monogr. Phan. 1 (1878) 629. [*Aglaia tarangisi* Elmer, Leafl. Philipp. Bot. 9 (1937) 3314, sine diagn. lat.]

Tree up to 15 m, sometimes flowering at 3.5 m. Bole up to 6 m, up to 15 cm in diam. Branches ascending, forming a narrow open crown. Outer bark greenish-grey or greyish-brown, with hoop marks, with pale lenticels in vertical rows; inner bark pale yellow to pinkish-brown; sapwood white or pale yellow; heartwood reddish-brown; latex white, copious. *Twigs* with few scales except at the apex which is densely covered with small delicate pale brown stellate scales. *Leaves* 18–43 cm long, 16–38 cm wide; petiole 3–12 cm, petiole, rachis and petiolules with occasional scales like those on the twigs. *Leaflets* 3–7, 4–23 by 1.5–7.5 cm, both surfaces matt when dry, acuminate at apex, usually cuneate, sometimes rounded at the slightly asymmetrical base, with very few scales like those on the twigs on the midrib below, often with numerous tiny shiny orange spots below; veins (4–)7–12 on each side of the midrib, orange-green when dry, reticulation subprominent below and visible above; petiolules 5–10(–30) cm long, with a swelling at the base, which is black when dry. Male *inflorescence* 11–31 cm long, 11–28 cm wide; peduncle 0.5–7 cm, peduncle, rachis and branches flattened, greenish-brown or pale brown when dry and with a few pale brown or nearly white scales like those on the twigs. Female inflorescence c. 19 cm long and 10 cm wide; peduncle c. 7 cm long. Male and female *flowers* similar, 0.7–1.5 mm long, 1–1.7 mm wide; pedicels 0.5–0.8 (–1.3) mm, calyx and pedicel with scattered stellate scales or none at all. *Petals* 5. *Staminal tube* dark yellow, 0.5–1 mm long, 0.7–1.5 mm wide, cup-shaped or obovoid, thickened inside below the anthers, the aperture c. 0.7 mm, sometimes with the margin incurved, anthers (4 or) 5, 0.3–0.5 mm long, up to 0.4 mm wide, protruding and pointing towards the centre of the flower and filling the aperture. *Infructescence* 20–25 cm long, 11–20 cm wide; peduncle 4–13 cm, peduncle, rachis and branches pale orange-brown when dry, with few scales like those on the inflorescence; fruitstalks c. 5 mm. *Fruits* 0.9–2 cm long, 0.5–0.8 cm wide, orange, obovoid when young, ellipsoid when ripe, (often asymmetrical when only one seed develops, and the stigma is displaced to one side during development of the fruit), with few scales like those on the twigs or none at all, pericarp orange-brown, papery thin and brittle when dry, orange or red when ripe and fresh. Locules 2, each containing 0 or 1 *seed*.

Distribution — *Malesia:* N Borneo, Philippines.

Habitat — Found in primary, secondary and gallery forest, and along seashore; on sandy soil; sealevel to 1330 m altitude.

Notes — 1. *Aglaia cumingiana* resembles *A. lawii* and *A. oligophylla* in its foliage, but it is distinguished by the indumentum, inflorescence and fruit.

2. In some respects, especially flower structure, *A. cumingiana* is like *A. parviflora*, but the latter is more robust, with larger leaves and twigs; the reticulation on the leaflets is not prominent; peltate scales with a fimbriate margin are numerous on the midrib below, while stellate scales are more abundant on the inflorescence; the fruits have dense scales on the outside.

67. Aglaia laxiflora Miq.

Aglaia laxiflora Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 52; Pannell, Kew Bull., Add. Ser. 16 (1992) 294.

Tree up to 10 m (?or more). Bole up to 4 m, up to 35 cm in diam. Bark light grey with numerous orange-brown depressions and scalloped pattern; inner bark reddish-pink, laminated; sapwood whitish-pink, with tiny rays. *Twigs* with small pale brown stellate scales densely covering the apex. *Leaves* up to 60 cm long and 48 cm wide; petiole up to 11 cm, petiole, rachis and petiolules with numerous scales like those on the twigs. *Leaflets* 11–14, 5–24 by 2–8 cm, acuminate at apex, usually cuneate, sometimes rounded at the base, with few to numerous scales like those on the twigs on the midrib below and few on the rest of that surface; veins 8–15 on each side of the midrib, the reticulation subprominent above and below; petiolules 5–7(–20) cm. *Inflorescence* up to 56 cm long and 40 cm wide; peduncle up to 14 cm, the branches slender and widely spaced giving the inflorescence a lax appearance, peduncle, rachis and branches with numerous scales like those on the twigs, more densely covering the distal branches. *Flowers* 1.1–1.2 mm long, 1.2–1.3 mm wide; pedicels 0.7–1 mm, with occasional scales like those on the twigs. *Calyx* without hairs or scales. *Petals* 5. *Staminal tube* 0.5–0.9 mm high, 0.9–1 mm wide, cup-shaped, the apical margin incurved, aperture 0.3–0.6 mm; anthers 5, 0.3–0.4 mm long, 0.3 mm wide, ovoid, dehiscent only in the lower half, darker at the apex, inserted inside the rim of the tube to 2/3 up the tube, protruding and filling the aperture. *Infructescence* up to 18 cm; peduncle 2–3 cm, peduncle, rachis and branches with few scales like those on the twigs. *Fruits* 5–6 cm long and c. 3.5 cm wide, ellipsoid or obovoid, orange or orange-yellow when ripe, indehiscent; pericarp 3–5 mm thick. Locules 2, each containing 0 or 1 seed; the fruit curved and asymmetrical when a seed fails to develop in one of the locules. *Seed* c. 3.1 cm long, 1.8 cm wide, 1 cm through, surrounded by an entire translucent aril 2–3 mm thick.

Distribution — *Malesia:* Borneo (Brunei, Sabah, Kalimantan).

Habitat — Found in primary forest, along ridges and along river banks, alluvial or occasionally flooded Dipterocarp forest with a low canopy; sometimes on limestone or sand; sealevel to 600 m altitude; common.

Note — The leaflets of *Aglaia laxiflora* are pale when dry, usually with subprominent reticulation above and below; the pale stellate scales are sparse on the leaflets, inflorescence and infructescence; the inflorescence is 'lax' and the pedicels are articulated; scales are sparse on the pedicels and absent from the calyx.

68. Aglaia pyriformis Merr.

Aglaia pyriformis Merr., Philipp. J. Sc., Bot. 13 (1918) 290; Pannell, Kew Bull., Add. Ser. 16 (1992) 295.
Aglaia puncticulata Merr., l.c.

Tree. *Twigs* usually densely covered with very dark reddish-brown peltate scales which have a reddish-brown fimbriate margin, with stellate scales of similar colour interspersed at the apex, sometimes with a few paler reddish-brown scales. *Leaves* 18–40

cm long, 11–29 cm wide; petiole 4–10 cm, petiole, rachis and petiolules densely covered with scales like those on the twigs. *Leaflets* 7–9, 5.5–17.5 by 2–5 cm, pale yellowish-green above and pale brownish-yellow below when dry, acuminate at apex, cuneate or rounded at the base; veins 6–11 on each side of the midrib; with scales like those on the twigs numerous on to densely covering the midrib above, few on to densely covering the veins above and either with similar scales or with scales which have a dark reddish-brown centre and a long white fimbriate margin few to numerous on the rest of the upper leaflet surface and on the lower leaflet surface, with numerous pits on both surfaces; petiolules 1–3 cm. *Male inflorescence* 20 cm long, 11 cm wide; peduncle 5 cm. *Male flower* c. 1 mm long and wide; pedicels c. 1 mm, pedicel and calyx densely covered with dark reddish-brown peltate scales which have a long paler fimbriate margin. *Petals* 5. *Staminal tube* 0.2–0.4 mm high, 0.7–0.8 mm wide, shallowly cup-shaped; anthers 5, c. 0.5 mm long and 0.3 mm wide, ellipsoid, inserted on the margin of the tube and curved over the stigma. *Female inflorescence* 15 cm long and 6 cm wide; peduncle 4 cm. *Female flowers* c. 3 mm long and wide; pedicels 0.2–1 mm. *Staminal tube* c. 1 mm high, 1.5 mm wide with an aperture 1.5 mm across; anthers 6, c. 0.6 mm long and 0.4 mm wide, inserted just inside the margin and pointing towards the centre of the flower; otherwise like the male. *Infructescence* 5–10 cm long. *Fruits* 3 cm long and 1.7 cm wide, obovoid, narrowed to a stipe 7 mm long, with scales like those on the twigs densely covering the outside; peduncle 2 mm. Locules 2, each containing 0 or 1 *seed*.

Distribution — *Malesia:* Philippines.

Habitat — In forests, altitude c. 300–400 m.

Notes — 1. *Aglaia pyriformis* has coriaceous leaflets which have numerous pits, often reddish-brown in colour, on both surfaces. In two of the three collections seen (the type collections of the two names), the upper surface of the leaflets has distinctive peltate scales in which the centre is very dark reddish-brown and the long fimbriate margin is white.

2. Merrill's two species are male (*A. puncticulata*) and female (*A. pyriformis*) plants of this species.

69. **Aglaia coriacea** Korth. ex Miq.

Aglaia coriacea Korth. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 57; Pannell in Tree Fl. Malaya 4 (1989) 214; Kew Bull., Add. Ser. 16 (1992) 297.

Small tree up to 5 m, usually unbranched, occasionally with 1 or 2 branches in the upper part of the tree. Bole up to 10 cm in circumference. Bark brown with green and grey patches, with longitudinal and transverse cracks and densely covered with reddish-brown stellate hairs at the apex; inner bark dark pinkish-red; sapwood slightly paler than inner bark; heartwood pale pinkish-red or yellowish-brown. *Leaves* imparipinnate, up to 120 cm long and 90 cm wide; petiole up to 35 cm, patent, the rachis descending, petiole, rachis and petiolules densely covered with often deciduous reddish-brown stellate hairs which have a dense cluster of short arms and a few up to 0.5 mm long. *Leaflets* 7–15, 13–43 by 4–9 cm, dark glossy green above, paler below, coriaceous, recurved

at margin, acuminate at apex, narrowed to a shortly cuneate or rounded sometimes asymmetrical base, with reddish-brown stellate hairs which are numerous on upper surface when young but deciduous before maturity, usually densely covering and conspicuous on the midrib on lower surface (but sometimes sparse) and numerous on the lower surface when young but usually deciduous before maturity; veins 11–33 on each side of the midrib; petiolules 1–35 mm. *Inflorescence* up to 6 cm long and wide, usually in the axils of the leaves, sometimes on the upper part of the stem below the lowest leaves; peduncle up to 1 cm, peduncle, rachis, branches, pedicels and calyx densely covered with reddish-brown stellate hairs. *Flowers* c. 2.5 cm long and 2 cm wide, obovoid; pedicels up to 2.5 mm long. *Petals* 5. *Staminal tube* about 3/4 the length of the corolla, obovoid, the aperture c. 0.6 mm in diam. and shallowly 5-lobed; anthers 5, about half the length of the staminal tube, ovoid, in the upper half of the tube and just protruding beyond the aperture. *Infructescence* with c. 6 fruits at different stages of ripening, tightly clustered at the end of a peduncle c. 9 cm long. *Fruits* 2.3–4 cm long, 1.8–3.5 cm wide, ellipsoid, brown, densely covered with dark brown stellate hairs like those on the twigs; pericarp 0.5–1 mm thick, leathery, inner surface white. Locules 1–3, septa disintegrating in ripe fruit. *Seeds* 2–3.5 cm long, 1.5–2 cm wide with inner surfaces flattened; aril 0.5–1 mm thick, the flesh translucent, white, sweet and juicy. — **Fig. 40.**

Fig. 40. *Aglaia coriacea* Korth. ex Miq. Fruit, longitudinally cut to show the two peltate cotyledons (left) and an uncut seed with translucent white aril (right). Kuala Lompat, Pahang, Malaysia (*Pannell 1407*). Photograph C.M. Pannell, 1979.

Distribution — *Malesia:* E & C Peninsular Malaysia, S Borneo (known only from the type collection) and Brunei (one collection only).

Habitat — Found in primary forest; up to 270 m altitude.

Note — A small unbranched tree with a terminal cluster of large pinnate leaves. The leaflets are coriaceous, when young the dark glossy green upper surface contrasts with the paler lower surface which has dense bright reddish-brown stellate hairs along the midrib and veins.

70. Aglaia oligophylla Miq.

Aglaia oligophylla Miq., Fl. Ind. Bat., Suppl. 1 (1861) 507; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 41; Pannell in Tree Fl. Malaya 4 (1989) 222; Kew Bull., Add. Ser. 16 (1992) 302, f. 90.
[*Meliacea singapureana* Wall., Cat. (1829) 1278, nom. nud.]
Aglaia oligantha C.DC. in DC., Monogr. Phan. 1 (1878) 603.
Aglaia fusca King, J. As. Soc. Beng. 64, ii (1895) 62; Pannell in Tree Fl. Malaya 4 (1989) 215.
Aglaia bordenii Merr., Philipp. Govt. Lab. Bur. Bull. 17 (1904) 22.
Aglaia polyantha Ridley, Kew Bull. (1930) 369. — [*Aglaia ridleyi* P.T. Li & X.M. Chen, Acta Phytotax. Sin. 22 (1984) 495, non Pannell (1982), nom. illeg., superfl. pro *Aglaia polyantha*.]
[*Aglaia anonoides* Elmer ex B.D. Jackson, Ind. Kew., Suppl. 10 (1947) 6, nom. in syn.]
Aphanamixis reticulosa Kosterm., Reinwardtia 7 (1965) 30, t. 10.

Tree up to 20(–25) m. Bole up to 10 m, up to 60(–90) cm in circumference, with small buttresses. Branches ascending or patent. Bark smooth, pinkish-brown, greyish-green or very pale grey, with orange longitudinal and round lenticels and green longitudinal streaks and transverse ridges, inner bark green or yellowish-brown; sapwood pale orange brown or pale yellow; very little white latex. *Twigs* slender, densely covered with or with numerous pale yellowish-brown stellate hairs or scales. *Leaves* imparipinnate, up to 40 cm long and 30 cm wide; petiole up to 9 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 3–11, 4.5–22 by 2–9 cm, subcoriaceous, both surfaces rather shiny when dry, acuminate-caudate at apex, cuneate or rounded at the asymmetrical base, with few to densely covered with pale brown stellate hairs on the midrib below and occasional on the rest of that surface; veins 5–10 on each side of the midrib, reticulation visible or subprominent on upper surface and subprominent on lower surface; petiolules up to 12(–20) mm. *Inflorescence* 10–20 cm long and 9–15 cm wide; peduncle up to 4 cm, peduncle, rachis and branches with surface and with numerous to densely covered with hairs like those on the twigs, the pedicels and calyx dark brown or black when dry and the calyx without or with very few pale brown stellate scales. *Flowers* up to 2 mm long and 2.5 mm wide; pedicels up to 1.5 mm. *Petals* 5. *Staminal tube* about half the length of the corolla, c. 1.3 mm across, depressed-globose with the aperture c. 0.8 mm across; anthers 5, obovoid, about half the length of the tube inserted about half way up the tube and just protruding beyond the aperture. *Infructescence* with few fruits; peduncle up to 2 cm. *Fruits* 1–3 cm in diameter, subglobose; the pericarp brown or yellow, either thin, hard and brittle or thick, woody and longitudinally ridged, densely covered with pale yellowish-brown stellate hairs on the outside. Locule(s) 1 or 2, each containing 1 *seed*, with a translucent gelatinous, white or brown, sweet edible aril.

Distribution — Andaman Islands, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo, Philippines.

Habitat — Found in deciduous and evergreen primary forest, secondary forest, swamp forest, riverine forest and in kerangas; on limestone, granite, basalt, sandy loam, clay; sealevel to 830 m altitude; few to rather common.

Note — The leaflets of *A. oligophylla* are either small and have dense pale brown stellate hairs only on the midrib or are larger and are almost without hairs or scales on the leaflets. Both surfaces are rather shiny when dry and the secondary venation is subprominent, resembling that of *A. odorata* Lour. (China, Indochina and Thailand; cultivated in Sumatra, Peninsular Malaysia and Java). It consistently differs from *A. odorata* in having terete petiolules throughout; the leaflets are usually much larger than those of *A. odorata*.

71. **Aglaia simplicifolia** (Bedd.) Harms

Aglaia simplicifolia (Bedd.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 300; Pannell, Kew Bull., Add. Ser. 16 (1992) 306, f. 92. — *Beddomea simplicifolia* Bedd., Fl. Sylv. 1 (1871) t. 135.
?*Beddomea racemosa* Ridley, J. Fed. Malay St. 4 (1909) 10. — *Aglaia mirabilis* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 145, 176.
Aglaia meliosmoides Craib, Kew Bull. (1913) 68; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 31; Pannell in Tree Fl. Malaya 4 (1989) 219.
Aglaia matthewsii Merr., Philipp. J. Sc., Bot. 13 (1918) 79.
Aglaia unifoliolata Ridley, Kew Bull. (1930) 369, nom. illeg., non Koorders (1898). — *Aglaia triandra* Ridley, Kew Bull. (1938) 215, nom. nov. pro *Aglaia unifoliolata* Ridley.
Aglaia haplophylla Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 474.
Aglaia odoardoi Merr., Webbia 7 (1950) 312.
Aglaia shawiana Merr., Webbia 7 (1950) 314.
Aglaia heterobotrys Merr., J. Arnold Arbor. 35 (1954) 138.
Aglaia sterculioides Kosterm., Reinwardtia 7 (1969) 434.
Aglaia neotenica Kosterm., Reinwardtia 7 (1969) 433.

Small tree up to 8(–20) m. Bole up to 20 cm in diam. Outer bark greyish-brown; inner bark reddish-brown; sapwood yellow or red; latex white. *Twigs* usually with reddish-brown stellate hairs, sometimes with peltate scales, densely covering the apex only, sparse elsewhere. *Leaves* simple, 15–32 by 4.5–10 cm wide, acuminate or caudate at apex, cuneate at the slightly asymmetrical base, upper surface often shiny and minutely pitted, the lower surface usually with occasional stellate hairs or scales, that surface sometimes densely covered with hairs or scales, veins 11–18 on each side of the midrib, the reticulation sometimes subprominent on upper surface, usually visible on lower surface; petiole up to 4 cm, with a swelling 0.5 cm long adjacent to the lamina and with occasional hairs or scales like those on the twigs. *Inflorescence* up to 15 cm long and 10 cm wide, peduncle up to 1 cm, peduncle, rachis, branches and pedicels densely covered with stellate hairs like those on the twigs. *Flowers* up to 2 cm long, pedicel up to 2 mm. *Calyx* densely covered with stellate scales. *Petals* 5. *Staminal tube* nearly as long as the corolla, obovoid, with a small aperture, apical margin entire; anthers about half the length of the tube, broadly ovoid, in the upper half of the tube, not or just protruding through the aperture. *Fruits* up to 4 cm long and wide, obovoid or subglobose, brown, red, orange or pale yellow, indehiscent, with a thick woody pericarp up to 5 mm thick

and densely covered with stellate hairs on the outside; pericarp often longitudinally ridged. Locules 1 or 2 (or sometimes 3 in India), each containing 1 *seed*; aril transparent, gelatinous.

Distribution — India, Laos, Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Borneo.

Habitat — Found in primary forest, secondary forest, evergreen forest, riverine forest and in ridge forest; understorey tree; on granite, sand, sandy loam, limestone, clay, sandstone; 7–1330 m altitude; rare and scattered to common.

Notes — 1. *Aglaia simplicifolia* has simple leaves; the shoot apex, petiole, inflorescence and fruit are densely covered with stellate hairs. The leaves are glabrous and the reticulation is sometimes subprominent on the upper surface of the leaves. This species resembles *A. oligophylla*, but it has simple leaves. It is variable in the texture of the leaflets which may be shiny or dull and the prominence of the midrib, lateral veins and reticulation, which are more prominent when the leaflet is shiny.

2. *Aglaia sterculioides* is treated as conspecific with *A. simplicifolia* and appears to be indistinguishable from it except in the fruit. The infructescence of '*A. sterculioides*' has 1 to 3 fruits and a peduncle 4–13.5 cm long. The fruit is narrowly ellipsoid, 7–7.5 cm long, 1.7–2 cm wide, with a stipe 1.5 cm long and a beak 1 cm long, longitudinally ridged, splits along the most prominent ridge on the concave side, the pericarp is thin, c. 1 mm, and the seed is 3.5 cm long and 1.5 cm wide.

72. **Aglaia monozyga** Harms

Aglaia monozyga Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 473; Pannell, Kew Bull., Add. Ser. 16 (1992) 311.

Small tree 3–10 m, bole up to 16 cm diam. Bark smooth, white, inner bark reddish-brown or yellowish-brown, cambium white. *Twigs* densely covered with reddish-brown stellate hairs which are soon deciduous. *Leaves* imparipinnate (or simple), 8–67 cm long, 2–52 cm wide; petiole 2.5–10(–14.5) cm long, petiole, rachis and petiolules densely covered with hairs like those on the twigs, deciduous. *Leaflets* (1–)3–5, 8–25(–46) by 3–7(–13) cm, pale green or yellowish-green when dry, coriaceous, recurved at margin when dry, densely covered with hairs like those on the twigs on both surfaces when young, deciduous, a few sometimes persisting on the midrib, the upper and lower surfaces rugulose and minutely pitted, acuminate or caudate at apex, cuneate or attenuate at the base, sometimes asymmetrical and rounded on one side; veins 6–15(–23) on each side of the midrib, curved upwards; petiolules 1–3.5(–4) cm long, flattened or channelled on the upper side, rounded below, swollen at the base. *Inflorescences* usually several per flowering shoot, the most distal often in the axil of an unopened leaf near the apex of the shoot, 11–3.5 cm long, 7–12 cm wide, peduncle up to 0.5 cm, peduncle, rachis and branches densely covered with reddish-brown or pale reddish-brown stellate hairs. *Male flowers* 1.2–2 mm long, 1.5–2.5 mm wide, pedicels 0.5–3.5 mm, pedicel and calyx densely covered with pale reddish-brown stellate hairs. *Petals* 5. *Staminal tube* cup-shaped or broadly cone-shaped 0.5–1.5 mm long, aperture c. 1 mm, with longitudinal thickenings forming ribs on the inside below the anthers; anthers 5, inserted

on the inner margin of the tube and pointing towards the centre of the flower, c. 0.5 mm long, dehiscing by short longitudinal slits in the lower half of the anthers, the apices of the anthers extending beyond these. *Female flowers* c. 3 mm long and 2.5 mm wide. *Staminal tube* c. 1.5 mm long and wide, cup-shaped; the aperture c. 1 mm; anthers 0.6–0.7 mm long; otherwise like the male. *Infructescence* up to 6 cm with 1 or 2 fruits; peduncle up to 3 cm. *Fruits* 1.7–3.5 cm long 1.3–3 cm in diam., subglobose or ellipsoid and sometimes with a small beak, indehiscent, pericarp orange or orange-red densely covered with or with numerous reddish-brown hairs or scales, deciduous on the ripe fruit; aril pink.

Distribution — *Malesia:* E Peninsular Malaysia (one gathering), Borneo.

Habitat — Found in primary forest, secondary forest, montane forest, riverine forest, and freshwater swamp forest; on sand, loam, laterite; 17–2000 m altitude.

Note — *Aglaia monozyga* is characterized by its long petiolules, attenuate leaf base, the leaflet margin slightly recurved towards lower surface, the matt texture of lower and upper leaflet surfaces and characteristic pale green or pale yellowish-green colour of the leaves when dry.

73–84. Aglaia tomentosa group

The species of this group are closely related. They have reddish-brown stellate hairs which, in some species in the group, are numerous on the lower surface of the leaflets with the arms of adjacent hairs overlapping to form a continuous indumentum on that surface of the leaflets; in other species the hairs are mainly on the midrib or they are numerous on the lower surface but the arms do not overlap. The hairs are interspersed with smaller, paler, stellate hairs or, sometimes, scales.

The species are separated on leaflet number, shape, hair structure and density of indumentum, correlated in some species with either flower or fruit characters.

Aglaia tomentosa has the greatest variation in leaflet number, size and the density of indumentum. The staminal tube is usually cup-shaped and the anthers protrude beyond the aperture; it is sometimes subglobose with a small apical pore. *Aglaia angustifolia* has numerous (13–21) very long, narrow leaflets with indumentum like that of *A. tomentosa*. In *A. rufibarbis* the leaflets are large and obovate, the hairs are present on both leaflet surfaces and have arms up to 4 mm or even 6 mm long. The staminal tube in *A. rufibarbis* is obovoid with a minute apical pore and the anthers are included. The arms of the hairs in *A. cuspidata* are also up to 4 mm long, whereas they rarely exceed 1 mm in the other species. The leaflets of *A. hiernii* have a more dense, darker indumentum than the other species and the calyx is usually glabrous. In *A. palembanica* the indumentum on leaves and fruits is sparse, while the number of leaflets in *A. exstipulata* is greater than in most other members of this group. *Aglaia exstipulata* is sometimes difficult to distinguish from *A. rufinervis*; this species and *A. tenuicaulis* are also related to *A. tomentosa*.

Aglaia tomentosa is widespread and occurs from India to New Guinea and Australia. Two species of this group are endemic to Fiji (*A. archboldiana* A.C. Smith and *A. fragilis* A.C. Smith).

73. Aglaia tenuicaulis Hiern

Aglaia tenuicaulis Hiern in Hook. f., Fl. Brit. India 1 (1875) 556; King, J. As. Soc. Beng. 64, ii (1895) 76; Ridley, Fl. Malay Penins. 1 (1922) 408; Pannell in Tree Fl. Malaya 4 (1989) 226; Kew Bull., Add. Ser. 16 (1992) 313.

Aglaia acuminatissima Teijsm. & Binn. var. *kambangana* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 48.

Small tree up to 10(–15) m. Bole up to 30 cm in circumference; unbranched or with a few ascending branches. Bark smooth, pale brown or grey with minute longitudinal cracks; inner bark pale yellowish-brown; sapwood pale brown or pale pinkish-brown; latex white. *Twigs* stout, densely covered with reddish-brown stellate hairs which have arms up to 1 mm long, with white latex. *Leaves* imparipinnate, up to 130 cm long and 75 cm wide, usually pale green when dry; petiole up to 25 cm long, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 7–11, 15–45 by 4–14 cm, shortly acuminate at apex, cuneate or rounded at base, with numerous stellate hairs on lower surface which sometimes have a few long arms which overlap with adjacent hairs but usually with the arms all short and not overlapping; veins 16–28 on each side of the midrib; petiolules up to 25 mm. Male *inflorescence* up to 40 cm long and wide. Female inflorescence up to 10 cm long and wide; peduncle, rachis and branches with indumentum like the twigs. *Flowers* c. 1.5 mm in diam.; pedicels up to 2 mm. *Calyx* densely covered with brown stellate scales on the outer surface. *Petals* 5. *Staminal tube* about 2/3 the length of the corolla, ellipsoid, 5-lobed, with a few hairs at the base on the inner surface; anthers 5, pale yellow, ovoid, about half the length of the tube and just protruding through the aperture. *Infructescence* up to 15 cm long and wide, with up to 25 fruits. *Fruits* 1.5–3 cm long, up to 2.5 cm wide, ellipsoid or subglobose; pericarp yellow or orange brown on the outside, densely covered with reddish-brown stellate hairs with many short arms and yellow on the inside. Locule(s) 1 or 2, each containing 1 seed. *Seed* reddish-brown, completely surrounded by a translucent, edible, sweet aril; testa reddish-brown.

Distribution — Thailand; *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Bunguran Island, Borneo, ?Philippines (Samar).

Habitat — Found in evergreen forest, riverine forest and primary forest; on sandy clay; sealevel to 1000 m altitude; rare to common.

Uses — Timber and firewood [Burkill, Dict. Econ. Prod. Malay Peninsula (1935) 76].

Note — *Aglaia tenuicaulis* is a small, often unbranched, tree with large leaves. It is common in Peninsular Malaysia and there is considerable variation in the size of leaflets and the density of hairs on the lower surface. The leaflets are usually large (up to 45 cm long and 14 cm wide) and the arms of adjacent hairs rarely overlap. The Borneo specimens are taller (up to 15 m) and branched; the arms of the stellate hairs are shorter than in those on specimens from the Malay Peninsula and Sumatra.

74. Aglaia membranifolia King

Aglaia membranifolia King, J. As. Soc. Beng. 64, ii (1895) 75; Ridley, Fl. Malay Penins. 1 (1922) 406; Pannell in Tree Fl. Malaya 4 (1989) 221; Kew Bull., Add. Ser. 16 (1992) 316.

Tree up to 10 m. Bole up to 15 cm in circumference. *Twigs* stout, with reddish-brown stellate hairs which have arms up to 1 mm long. *Leaves* imparipinnate, 75–175 cm long, up to 115 cm wide; petiole up to 25 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 7–11, 35–57 by 10–15.5 cm, rather membraneous, acuminate at apex, tapering to a subcordate base, with scattered hairs like those on the twigs and smaller stellate hairs with fewer arms and stellate scales interspersed on lower surface; veins 23–47 on each side of the midrib, the reticulation visible on lower surface; petiolules up to 10(–20) mm. *Inflorescence* up to 40 cm long and 12 cm wide; peduncle up to 7 cm, the peduncle, rachis, branches and pedicels with indumentum like the twigs. *Flowers* up to 1.5 mm in diam., subglobose. *Calyx* densely covered with stellate hairs, deeply divided into 5 subrotund lobes. *Petals* 5. *Staminal tube* about half the length of the corolla, cup-shaped, slightly incurved and shallowly lobed at the apical margin; anthers about 1/3 the length of the tube, inserted just below the aperture, protruding beyond it and pointing towards the centre of the flower. *Fruits* up to 2 cm long and 1.5 cm wide, pyriform, densely covered with orange-brown stellate scales. Locules 2, each containing 1 *seed*.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia.

Habitat — Found in primary forest; 330–500 m altitude.

Note — *Aglaia membranifolia* resembles *A. tenuicaulis*, but the leaflets of the former taper gradually to a subcordate base whereas it is rounded or cuneate in *A. tenuicaulis*. The lateral veins are usually more numerous than in *A. tenuicaulis* and the secondary venation is conspicuous. It is known from only a few specimens from Peninsular Malaysia and Sumatra.

75. Aglaia rufinervis (Blume) Bentv.

Aglaia rufinervis (Blume) Bentv., Acta Bot. Neerl. 11 (1962) 19; Backer & Bakh. f., Fl. Java 2 (1965) 127; Pannell, Kew Bull., Add. Ser. 16 (1992) 317, f. 96. — *Trichilia rufinervis* Blume, Bijdr. (1825) 164. — *Heynea quinquejuga* Spreng., Syst. 4 (1827) 252, nom. superfl. pro *Trichilia rufinervis*, non Roxb.; G.Don, Gen. Syst. 1 (1831) 685; M. Roem., Synops. Monogr. 1 (1846) 197.

Aglaia trichostemon C.DC. in DC., Monogr. Phan. 1 (1878) 608; King, J. As. Soc. Beng. 64, ii (1895) 77; Ridley, Fl. Malay Penins. 1 (1922) 407; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 76; Pannell in Tree Fl. Malaya 4 (1989) 227.

Aglaia montana C.DC., Ann. Conserv. & Jard. Bot. Genève 15/16 (1912) 246; Backer & Bakh. f., Fl. Java 2 (1965) 129.

Aglaia borneensis Merr., J. Str. Br. Roy. As. Soc. 76 (1917) 87.

Aglaia winckelii Adelb., Blumea 6 (1948) 321.

Tree up to 15 m with a small, sometimes open crown. Bole up to 10 m, up to 50 cm in circumference. Bark smooth, brown or grey, with minute vertical cracks; inner bark pale orange-brown; sapwood pale orange-brown or reddish-brown; latex white. *Twigs* stout, densely covered with dark brown stellate hairs. *Leaves* imparipinnate, up to 100 cm long and 40 cm wide; petiole up to 12 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 15–19, 6–28.5 by 3–8 cm, shortly caudate at apex, rounded or cuneate at the asymmetrical base, upper surface rugulose and pitted, lower surface with numerous pits and densely covered with reddish-brown stellate scales on

the midrib and brown or pale brown stellate scales and hairs evenly scattered on lower surface; veins 9–18 on each side of the midrib, reticulation visible on lower surface; petiolules up to 15(–30) mm. Male *inflorescence* up to 80 cm long and 75 cm wide, peduncle, rachis and branches densely covered with reddish-brown stellate scales, the ultimate branches and pedicels with numerous to densely covered with scales. *Flowers* c. 1.2 mm long and 1.1–1.2 mm wide, subglobose or slightly longer than broad, fragrant; pedicel 0.3–1 mm. *Calyx* with few to densely covered with reddish-brown stellate scales on the outer surface. *Petals* 5. *Staminal tube* c. 0.9 mm long and 0.8 mm wide, shorter than the petals, obovoid, aperture c. 0.3 mm, shallowly 5-lobed, with pale yellow stellate hairs on the inner surface; anthers 5, c. 0.5 mm long and 0.3 mm wide, obovoid, with pale yellow stellate hairs, inserted in the upper half of the tube and just protruding through the aperture. *Infructescence* up to 16 cm long and wide. *Fruits* up to 20 cm in diam., subglobose, brown or orange, densely covered with dark brown or orange-brown stellate hairs and scales on the outside; fruitstalks up to 2 mm. Locule 1, containing 1 *seed*; aril translucent, sour; testa dark brown.

Distribution — *Malesia:* Peninsular Malaysia, Singapore, Sumatra, Borneo, Java.

Habitat — Found in primary and secondary forest; on coral limestone, sandy loam and clay; sealevel to 1330 m altitude; common.

Note — The leaves of *Aglaia rufinervis* have 15–19 leaflets which distinguishes this species from *A. tenuicaulis* and *A. membranifolia*, both of which have fewer leaflets. The pale brown stellate hairs and scales scattered on the lower surface of the leaflets are often inconspicuous.

76. Aglaia exstipulata (Griff.) Theob.

Aglaia exstipulata (Griff.) Theob. in Mason, Burma, ed. 3, 2 (1883) 583; Balakrishnan, J. Bombay Nat. Hist. Soc. 67 (1970) 57; Pannell in Tree Fl. Malaya 4 (1989) 215; Kew Bull., Add. Ser. 16 (1992) 320, f. 98. — *Euphoria exstipulata* Griff., Notul. 4 (1854) 547 ('*Euphora exstipulatis*').

Aglaia longifolia Teijsm. & Binn., Nat. Tijds. Ned.-Indië 27 (1864) 2.

Aglaia minutiflora Bedd. var. *griffithii* Hiern in Hook. f., Fl. Brit. India 1 (1875) 557. — *Aglaia griffithii* (Hiern) Kurz, J. As. Soc. Beng. 44, ii (1875) 146, nom. superfl. illeg. pro *Euphoria exstipulata* Griff.; King, J. As. Soc. Beng. 64, ii (1895) 75; Ridley, Fl. Malay Penins. 1 (1922) 409.

Tree up to 25 m, with a rounded or conical finely branched crown. Bole up to 15 m, up to 50 cm in circumference. Bark smooth, brown or greyish-brown, with lenticels in longitudinal rows; inner bark pale brown; sapwood pale yellowish-brown; latex white. *Twigs* slender, densely covered with reddish-brown stellate hairs. *Leaves* imparipinnate, up to 60 cm long and 35 cm wide, petiole up to 11 cm, petiole, rachis and petiolules with hairs like those on the twigs. *Leaflets* 11–23, 6–16 by 1.5–4 cm, the margin rather wavy, acuminate or caudate at apex, rounded or cuneate at the asymmetrical base, with hairs like those on the twigs on the depressed midrib on upper surface, densely covering the midrib and numerous on rest of the lower surface and with smaller, paler, fewer-rayed stellate hairs, interspersed, with numerous pits on both surfaces in Borneo; veins 7–16 on each side of the midrib, reticulation prominent in Sarawak; petiolules up to 10(–20) mm. *Male inflorescence* up to 40 cm long and wide, peduncle up to 5 cm,

peduncle, rachis, branches and pedicels densely covered with hairs like those on the twigs. *Male flowers* minute, up to 0.8 mm in diam.; pedicels up to 0.8 mm. *Calyx* with numerous to densely covered with reddish-brown stellate hairs on the outer surface. *Petals* 5. *Staminal tube* deeply divided into 5 lobes; anthers small, ovoid, pointing obliquely upwards towards the centre of the flower. *Female inflorescence* smaller and less branched than the male. *Female flowers* larger, 1.5 mm long. *Staminal tube* cup-shaped with the apical margin incurved leaving a small aperture, obscurely 5-lobed; anthers 5, minute and inserted below the rim, with a few pale yellow hairs; otherwise like the male. *Infructescence* up to 25 cm long. *Fruits* up to 3 cm long and 1.5 cm wide, subglobose or pyriform, red, orange, brown or grey, densely covered with stellate hairs like those on the twigs. Locules 2, each containing 1 seed. *Seed* surrounded by a white edible aril.

Distribution — Burma, Thailand, Vietnam; *Malesia:* Peninsular Malaysia, Singapore, Borneo.

Habitat — Found in evergreen forest, primary forest, secondary forest, along ridges and roads on sand, granite, shale, clay-loam; 50–1400 m altitude.

Uses — Aril edible. Burkill [Dict. Econ. Prod. Malay Penins. (1935) 74] stated that the wood is used for house-building in Celebes, where this species does not occur; he may be referring to *A. tomentosa*.

Notes — 1. *Aglaia exstipulata* is intermediate in characters between *A. tomentosa* and *A. palembanica*. *Aglaia tomentosa* has fewer and broader leaflets which usually have a dense covering of stellate hairs on the lower surface, with the arms of adjacent hairs overlapping. In *A. exstipulata* the arms of adjacent hairs do not overlap. The leaves of *A. palembanica* usually have fewer and smaller leaflets with sparser indumentum, which often consists partly of peltate scales, and the ripe fruit are smaller.

2. *Aglaia exstipulata* shows some variation in leaflet size and fruit shape. Specimens from high altitudes often have fewer, larger leaflets and pyriform fruits whereas those from lower elevations have subglobose fruits. The lectotype, which comes from Burma, has fewer larger leaflets, but subglobose fruits.

77. **Aglaia palembanica** Miq.

Aglaia palembanica Miq., Fl. Ind. Bat., Suppl. 1 (1861) 197, 507; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 52; Hiern in Hook. f., Fl. Brit. India 1 (1875) 557; King, J. As. Soc. Beng. 64, ii (1895) 72, p.p.; Ridley, Fl. Malay. Penins. 1 (1922) 409, p.p.; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131; Pannell in Tree Fl. Malaya 4 (1989) 223; Kew Bull., Add. Ser. 16 (1992) 323, f. 100.

Aglaia sipannas Miq., Fl. Ind. Bat., Suppl. 1 (1861) 197, 506; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 53.

Aglaia pamattonis Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 53.

Tree up to 5 m, with an irregularly rounded crown. *Twigs* slender, densely covered with brown stellate hairs which have arms up to 0.7 mm long. *Leaves* up to 36 cm long and 25 cm wide; petiole up to 10 cm, petiole, rachis and petiolules densely covered with hairs like those on the twigs. *Leaflets* 9–13, 6–22.5 by 1.3–3.5 cm, the margin slightly wavy and recurved when dry, caudate or acuminate at apex, cuneate and sometimes rounded on one side at the asymmetrical base, with stellate hairs like those on the twigs

evenly scattered on lower surface and some paler stellate scales or peltate scales with a long fimbriate margin interspersed; veins 9–13 on each side of the midrib, some reticulation visible on lower surface; petiolules up to 8 mm. *Inflorescence* up to 30 cm long and wide, the final branches up to 10 mm long and tightly packed with sessile flowers, the branches clothed like the twigs. *Flowers* c. 1.2 mm long, subglobose or slightly longer than broad. *Calyx* with few or many pale brown stellate hairs on the outer surface. *Petals* 5. *Staminal tube* c. 0.8 mm long, cup-shaped with the apical margin incurved; anthers ovoid about half the length of the tube and just protruding beyond the aperture. *Infructescence* up to 10 cm long. *Fruits* subglobose, up to 4 mm long, brown or red, the pericarp thin and brittle and with few hairs like those on the twigs.

Distribution — *Malesia:* S Sumatra, S Peninsular Malaysia, Borneo, Philippines.

Habitat — Found on flood plains, along river banks and in primary and secondary forest; on clay, laterite, sandstone, sand, limestone; sealevel to 450 m altitude.

Note — *Aglaia palembanica* is similar to *A. exstipulata*, but has fewer, smaller leaflets with the indumentum usually sparse. When the hairs on the lower surface of the leaflets are more numerous (as they sometimes are in the Philippines), *A. palembanica* resembles *A. tomentosa*, but it usually has more leaflets than the latter. The fruits of *A. palembanica* are characteristic, being small, subglobose and glabrescent. The fruits of *A. tomentosa* are sometimes glabrescent in the Philippine Islands, but they are larger than those of *A. palembanica*. Nevertheless, the distinction of *A. tomentosa* from *A. palembanica* in the Philippines is sometimes difficult if fruits are not present.

78. **Aglaia brownii** Pannell

Aglaia brownii Pannell, Kew Bull., Add. Ser. 16 (1992) 327.

Small tree 2–12 m. Bark pale brown or grey; sapwood white. *Twigs* slender, densely covered with pale brown stellate scales and hairs. *Leaves* imparipinnate or occasionally trifoliolate, 15–45 cm long, 12–40 cm wide; petiole 4–12 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* (3–)5–9, 4.5–20 by 1.5–8 cm, the leaflet margin sometimes strongly recurved (apparently when growing in dry conditions), the apex acuminate, cuneate or rounded at the slightly asymmetrical base, with pale brown stellate scales on the lower surface, densely covering the midrib, numerous elsewhere, sometimes interspersed with compact stellate hairs in which all the arms are usually of similar length; veins 9–15 on each side of the midrib, reticulation often white or pale brown on the lower surface when dry; petiolules 3–10 mm. *Inflorescence* 7–20 cm long, 3–27 cm wide, in the axils of 1 to 3 leaves near the twig apex; peduncle 1–4 cm, peduncle, rachis and branches with indumentum like the twigs. *Flowers* c. 1 mm long, 1–1.5 mm wide, strongly perfumed; pedicels 0.5–2 mm, densely covered with pale brown stellate hairs. *Calyx* densely covered with pale brown stellate hairs on the outer surface. *Petals* 5. *Staminal tube* c. 0.5 mm long, cup-shaped, the apical margin shallowly 5-lobed; anthers (3–)5 (6), c. 0.4 mm long and wide, ovoid, brown with a pale yellow margin when dry, inserted inside the margin of the tube and pointing towards the centre of the flower, sometimes in New Guinea with numerous pale simple hairs on

the margin of the staminal tube and on the anthers. *Infructescence* 9–19.5 cm long, 3–4 cm wide; peduncle 2–6.5 cm, peduncle, rachis and branches densely covered with hairs and scales like those on the twigs. *Fruits* c. 2 cm long and 1.5 cm wide, orange when ripe, obovoid or subglobose, indehiscent, densely covered with hairs and scales like those on the twigs; pericarp thin, brittle when dry. Locules 2, each containing 1 *seed*.

Distribution — Australia (Northern Territory and Queensland); *Malesia:* New Guinea.

Habitat — Found on rocks and dunes near the sea, monsoon forest on coastal dunes, fringing coastal woods, semi-deciduous notophyll vine forest at edge of beach close to mangroves, *Eucalyptus* forest. Grows on dark brown organic soil, aeolian sands, stabilized dune or laterite.

Notes — 1. *Aglaia brownii* resembles *A. tomentosa* but differs from it in having numerous pale brown stellate scales on the lower surface of the leaflet with some stellate hairs interspersed. The stellate hairs of *A. tomentosa* are reddish-brown, with the arms of the same hair differing in length and up to 1 mm long, whereas in *A. brownii* the hairs are paler brown and have shorter arms which are usually all of similar length.

2. *Aglaia brownii* bears some resemblance to *A. elaeagnoidea* but differs markedly from it in having an indumentum of stellate hairs and scales rather than the peltate scales which are typical of *A. elaeagnoidea*, to which specimens of *A. brownii* were referred.

79. Aglaia tomentosa Teijsm. & Binn.

Aglaia tomentosa Teijsm. & Binn., Nat. Tijds. Ned.-Indië 27 (1864) 43; Pannell in Tree Fl. Malaya 4 (1989) 226; Kew Bull., Add. Ser. 16 (1992) 331.

Argophilum pinnatum Blanco, Fl. Filip., ed. 1 (1837) 186; ed. 2 (1845) 131; ed. 3, 2 (1877) 235. — *Aglaia pinnata* (Blanco) Merr., Sp. Blanc. (1918) 212, non *Aglaia pinnata* (L.) Druce (1914) (= *Vitex pinnata* L., *Labiatae-Viticoideae*).

Aglaia rufa Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 49, excl. syn.

Aglaia zippelii Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 54.

Aglaia cordata Hiern in Hook. f., Fl. Brit. India 1 (1875) 557; King, J. As. Soc. Beng. 64, ii (1895) 73, p.p.; Ridley, Fl. Malay Penins. 1 (1922) 409, p.p.; Pannell in Tree Fl. Malaya 4 (1989) 214.

Aglaia dyeri Koord., Minah. (1898) 634.

[*Aglaia palembanica* Miq. var. *borneensis* Miq. ex Koord., Minah. (1898) 382, nom. nud.]

?*Aglaia ramuensis* Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 386.

Aglaia bamleri Harms, op.cit. (1900) 385, syn. nov.

Aglaia glomerata Merr., Philipp. Govt. Lab. Bur. Bull. 35 (1906) 30.

Aglaia kabaensis Baker f., J. Bot. Lond. 62, Suppl. (1924) 19.

Aglaia elaphina Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 316.

Usually a small tree, sometimes up to 15(–23) m. Bole up to 9 m, up to 20 cm in diam.; branches ascending or patent. Outer bark pale reddish-brown or grey with green patches, with longitudinal cracks and lenticels in longitudinal rows; inner bark yellow, fibrous or granular; sapwood pale brown or pinkish-brown; latex white. *Twigs* slender, densely covered with reddish-brown or sometimes orange-brown stellate hairs which have arms up to 1 mm long. *Leaves* imparipinnate, 13–60 cm long, 13–50 cm wide; petiole up to 13 cm long, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 5–11(–13), 2.5–32 by 1.5–11 cm, often recurved at the margin when dry, acuminate or caudate at apex, tapering to a cuneate, rounded or cordate asymmetrical

Fig. 41. *Aglaia tomentosa* Teijsm. & Binn. a. Habit with male inflorescences; b. half male flower; c. female inflorescences; d. half female flower; e. infructescences; f. stellate hair (a, b, f: *Pannell 2036*; c, d: *Pannell 2039*; e: *Jugah Kudi S 27757*). Drawing R. Wise.

base, with hairs like those on the twigs usually absent but sometimes densely covering the midrib on upper surface, numerous on to densely covering the midrib and veins and numerous on the rest of the lower surface, the arms of adjacent hairs usually overlapping, with smaller paler hairs which have fewer and shorter arms interspersed on the surface in between; veins 5–25 on each side of the midrib, reticulation visible on lower surface; sessile or with petiolules up to 10(–20) mm. Male *inflorescence* up to 9–18 cm long, 3–22 cm wide; peduncle 1–3 cm, peduncle, rachis and branches with indumentum like the twigs. Female inflorescence smaller and with fewer branches than the male; otherwise like the male. *Flowers* 1–4 mm long and in diam., sessile. *Calyx* densely covered with stellate hairs on the outside. *Petals* 5. *Staminal tube* about half the length of the corolla, either cup-shaped, slightly incurved and shallowly 5-lobed at the apical margin, or subglobose, c. 1 mm in diam. with the aperture c. 0.4 mm across; anthers 5, half to as long as the length of the tube, broadly ovoid, inserted near the base or just below the margin of the tube, usually protruding, curved and pointing towards the centre of the flower. *Infructescence* 5–19 cm long and 15 cm wide, with up to 15 fruits; peduncle c. 1 cm, with indumentum like the twigs. *Fruits* 1.6–2.5 cm long, 1.2–1.7 cm in diam., yellow, subglobose or pyriform, with indumentum like the twigs; fruitstalks up to 5 mm. Locule(s) 1 or 2, each containing 0–1 seed. *Seed* with a complete orange, red or brown, gelatinous, translucent, acidic-tasting aril. — **Fig. 41.**

Distribution — S India, Vietnam, Laos, Thailand, Australia (Cape York Peninsula); *Malesia:* Sumatra, Peninsular Malaysia, Singapore, Borneo, Philippines, Celebes, Lesser Sunda Islands (Flores), New Guinea.

Habitat & Ecology — Found in evergreen forest, primary forest, secondary forest, riverine forest, montane forest, ridge forest; sometimes periodically inundated; on sandstone, alluvial, granite, limestone, sand, loam, laterite, clay; sealevel to 2000 m altitude; scattered to common. Fruit eaten by monkeys.

Uses — Timber used in house-building, but not durable [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 73].

Notes — 1. *Aglaia tomentosa* is one of the most widespread and variable species of *Aglaia* and it has c. 13 closely related species, each more restricted in its range than *A. tomentosa*.

2. Examination of authentic material (WRCL) of *A. bamleri* Harms showed it to belong here. See Pannell, Kew Bull., Add. Ser. 16 (1992) 350, under 'Names not placed'.

80. Aglaia integrifolia Pannell

Aglaia integrifolia Pannell, Kew Bull., Add. Ser. 16 (1992) 336.

Small tree up to 3 m, with few branches. *Twigs* densely covered with reddish-brown stellate hairs. *Leaves* simple, 12–23 by 3–9 cm, acuminate at apex, rounded to a subcordate base, with hairs like those on the twigs numerous on the lower surface of the leaf, the arms of adjacent hairs overlapping and with smaller, paler hairs interspersed; veins 13–32 on each side of the midrib; petiole 2–4 cm, densely covered with hairs like those on the twigs. *Inflorescence* 1.5–2 cm long, with linear bracteoles up to 3 mm

long; peduncle, rachis and branches densely covered with hairs like those on the twigs. *Flowers* 2 mm long and 4 mm wide, sessile or with pedicels up to 0.5 mm; pedicels and calyx with a few stellate hairs which have arms up to 1 mm long. *Petals* 5. *Staminal tube* c. 1 mm long and wide, obovoid, aperture c. 1 mm wide; anthers 5, pale, half the length of the tube, inserted just inside the margin and pointing towards the centre of the flower. *Infructescences* in the axils of leaves near the apex of the shoot. *Fruits* solitary or in pairs, subglobose, densely covered with hairs like those on the twigs.

Distribution — *Malesia:* Papua New Guinea.

Habitat — Found in lowland and deciduous hill forest; up to 585 m altitude.

Notes — 1. *Aglaia integrifolia* resembles *A. tomentosa* except that it is a smaller tree and has simple leaves. The lower surface of the leaflets has numerous pale orange-brown or reddish-brown stellate hairs, which have long arms, and smaller, paler hairs interspersed.

2. *Aglaia integrifolia* is the only species in the *A. tomentosa* group which has simple leaves.

81. Aglaia angustifolia (Miq.) Miq.

Aglaia angustifolia (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 55; C.DC. in DC., Monogr. Phan. 1 (1878) 617; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131; Pannell in Tree Fl. Malaya 4 (1989) 211; Kew Bull., Add. Ser. 16 (1992) 337, f. 106. — *Hartighsea angustifolia* Miq., Fl. Ind. Bat., Suppl. 1 (1861) 196, 504.

Hearnia beccariana C.DC. in DC., Monogr. Phan. 1 (1878) 629. — *Aglaia beccariana* (C.DC.) Harms in Engl. & Prantl., Nat. Pflanzenfam. 3, 4 (1896) 298.

?*Aglaia angustifolia* (Miq.) Miq. var. *horsfieldiana* C.DC. in DC., Monogr. Phan. 1 (1878) 617.

Aglaia stenophylla Merr., Philipp. J. Sc., Bot. 11 (1916) 185.

Small tree up to 3.5(–8) m, unbranched or rarely forked. Stem or bole up to 10 cm in diam. Outer bark smooth, greyish-green or pale brown, with large lenticels; inner bark pale orange or brown; sapwood pale yellowish-brown, becoming orange or brown towards the centre; latex white. *Twigs* stout, densely covered with reddish-brown stellate hairs which have arms up to 1 mm long. *Leaves* imparipinnate, up to 100 cm long and 80 cm wide; petiole up to 15 cm, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* 13–21(–25), 15–40 by 1–4 cm, linear-lanceolate, apex caudate, acute, base asymmetrical, rounded or subcordate, with numerous to densely covered with hairs like those on the twigs on the midrib on lower surface, few to numerous on the veins, sparse to numerous on the lamina with the arms of adjacent hairs usually overlapping and with smaller paler hairs with fewer arms on the surface in between; veins 18–25 on each side of the midrib, reticulation usually visible; petiolules 0–5 mm. *Inflorescence* up to 20 cm long and 12 cm wide; peduncle up to 3 cm, peduncle, rachis, branches and pedicels with numerous to densely covered with brown hairs like those on the twigs. *Flowers* c. 1.5 mm long; pedicels up to 1.5 mm. *Calyx* with numerous stellate scales on the outside. *Petals* 5. *Staminal tube* about 2/3 the length of the corolla, subglobose, irregularly lobed at the apical margin, anthers 5, about half the length of the tube, ovoid, just protruding through the aperture. *Infructescence* up to 10 cm long; peduncle

c. 5 mm, peduncle, rachis, branches and fruitstalks with indumentum like the inflorescence. *Fruits* up to 2 cm in diam., subglobose, yellowish-green or yellowish-brown; pericarp soft and mealy, densely covered with reddish-brown stellate hairs on the outside. Locules 2, each containing 1 seed. *Seed* pale yellowish-green with a complete translucent aril.

Distribution — *Malesia:* N & C Sumatra, S Peninsular Malaysia (Johore), S & W Borneo, Bunguran Island, Philippines (known only from the type collection of *A. stenophylla*).

Habitat — Found in primary lowland and hill forest, swamp forest, sometimes along rivers, road-sides, kerangas forest on sandy and yellow-red loamy soil; 35–1450 m altitude; often common.

Note — *Aglaia angustifolia* is a small, unbranched tree. The large leaves have 13 to 21 very long and narrow leaflets. The indumentum on the lower surfaces of the leaflets is usually like that of *A. tomentosa* but may be less dense on old leaves.

82. Aglaia hiernii King

Aglaia hiernii King, J. As. Soc. Beng. 64, ii (1895) 74; Ridley, Fl. Malay Penins. 1 (1922) 408; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 131; Pannell in Tree Fl. Malaya 4 (1989) 218; Kew Bull., Add. Ser. 16 (1992) 341.
[*Aglaia cordata form 1*: Hiern in Hook. f., Fl. Brit. India 1 (1875) 557, quoad *Maingay 2493.*]
Aglaia curtisii King, J. As. Soc. Beng. 64, ii (1895) 71.
Aglaia caudatifoliolata Merr., Univ. Calif. Publ. Bot. 15 (1929) 126.
Aglaia ochneocarpa Merr., Contr. Arnold Arbor. 8 (1934) 83.

Tree up to 30 m, with broad rounded crown. Bole up to 100 cm in circumference. Bark greenish-brown or grey with fine longitudinal lines of lenticels; inner bark green; sapwood green, pink, pale yellow or white; latex white. Branches ascending or patent. *Twigs* fairly stout, densely covered with dark reddish-brown stellate hairs with arms up to 1 mm long. *Leaves* imparipinnate, up to 70 cm long and 60 cm wide; petiole up to 18 cm, rachis, petiole and petiolules densely covered with stellate hairs like those on the twigs. *Leaflets* (7–)9(–13), 7–30 by 4–11 cm, yellowish-green when young, recurved at the margin for up to 1 cm when dry, shortly caudate at apex, rounded at the base, when young the upper surface pale brown stellate and darker reddish-brown stellate hairs densely covering the midrib, numerous on the lateral veins and a few interspersed with stellate scales on the upper surface, both deciduous before maturity, lower surface with reddish-brown stellate hairs which have arms up to 1 mm long densely covering the midrib and numerous on the surface with the arms of adjacent hairs usually overlapping, interspersed with numerous pale brown stellate scales or hairs which have few ascending arms; veins 12–25 on each side of the midrib; petiolules up to 10(–25) mm. *Inflorescence* up to 35 cm long and wide; peduncle up to 5 cm, the peduncle, rachis and branches with indumentum like the twigs, the final branches up to 7 mm long and tightly packed with sessile flowers. *Flowers* c. 1 mm in diam. *Calyx* glabrous or with occasional stellate scales (in Borneo indumentum dense). *Petals* 5. *Staminal tube* shorter than the corolla, cup-shaped with the apical margin incurved leaving a small aperture; anthers

5, ovoid, inserted just below the margin of the tube, apices with pale stellate hairs which cover the aperture of the tube. *Infructescence* c. 35 cm long, with few fruits, peduncle, rachis and branches stout. *Fruits* 5 cm long and 3.5 cm wide, obovoid or ellipsoid, brown or yellow; pericarp 2–4 mm thick, woody when dry and densely covered with stellate hairs or scales on the outside. Locule 1, containing 1 seed. *Seed* with aril c. 2.9 cm long, 1.9 cm wide and 1.7 cm through; aril c. 1.5 mm thick, translucent, pale orange, sweet and edible.

Distribution — *Malesia:* Sumatra, Peninsular Malaysia, Borneo.

Habitat — Found in primary forest, secondary forest ; on granite, sand, sandstone, clay, clay-loam; 20–1700 m altitude.

Notes — 1. The leaflets of *Aglaia hiernii* have a dense indumentum of dark reddish-brown stellate hairs on the lower surface. The flowers are sessile and the calyx glabrous. It appears that at high altitudes the leaves are larger and the indumentum less dense. A young tree from Maxwell's Hill (*Pannell 1353*, FHO) had very large leaves. The fruits are large and have a thick woody pericarp which distinguishes this species from others in the *tomentosa* group.

2. *Aglaia hiernii* is less distinct in Borneo because *A. tomentosa* may have a glabrous calyx and *A. hiernii* a hairy one.

3. Some specimens from Sumatra and Borneo are intermediate between *A. hiernii* and *A. exstipulata* and are provisionally placed in *A. hiernii*. If these specimens are correctly excluded from *A. exstipulata*, that species has not been recorded from Sumatra.

83. Aglaia cuspidata C.DC.

Aglaia cuspidata C.DC., Nova Guinea, Bot. 8 (1910) 426; Pannell, Kew Bull., Add. Ser. 16 (1992) 343.

Tree up to 12 m high; bole up to 8 m, up to 20 cm in diam. Outer bark grey brown; middle bark red; inner bark pink. Sapwood cream; heartwood pinkish-brown. *Twigs* with numerous reddish-brown stellate hairs which have arms up to 6 mm long, dense on young twigs but soon glabrescent, dark reddish-brown stellate scales interspersed. *Leaves* 44 cm long, 52 cm wide, petiole 8–17 cm long, petiole, rachis and petiolules with dense hairs like those on the twigs. *Leaflets* 5–7, 11–26 by 4–8 cm, acuminate at apex, tapering to a subcordate base, with dense hairs like those on the twigs on the midrib below; veins 12–19 on each side of the midrib, reticulation visible; petiolules c. 5 mm. *Infructescence* 37 cm long, sparsely branched, peduncle up to 24 cm long, slender and flexible. *Fruits* c. 2.5–3 cm long and 1.6–3 cm wide, orange, obovoid or subglobose, pericarp thin and brittle when dry, with numerous hairs like those on the twigs. Locule 1. *Seed* 1, c. 1.9 cm long, 1.7 cm wide and 1.4 cm thick, no aril seen, testa vascularized.

Distribution — *Malesia:* S Papua New Guinea.

Habitat — Found in rain forest; c. 366 m altitude.

Note — The long-armed stellate hairs of *Aglaia cuspidata* resemble those of *A. rufibarbis*, but they are sparse on the leaflets and the fruits are glabrescent. The fruits are like those of *A. tomentosa*, with a thin brittle pericarp.

Fig. 42. *Aglaia rufibarbis* Ridley. Male inflorescences. Kuala Lompat, Pahang, Malaysia (*Pannell 1292*). Photograph C.M. Pannell, 1978.

84. **Aglaia rufibarbis** Ridley

Aglaia rufibarbis Ridley, J. Str. Br. Roy. As. Soc. 75 (1917) 17; Fl. Malay Penins. 1 (1922) 409; Pannell in Tree Fl. Malaya 4 (1989) 225; Kew Bull., Add. Ser. 16 (1992) 344, f. 110.
[*Aglaia rufa* auct. non Miq.: Ridley, J. Str. Br. Roy. As. Soc. 54 (1910) 32].

Tree up to 10 m, with an ovoid crown. Bole up to 4 m, up to 21 cm in circumference. Bark usually grey and pale brown, sometimes dark brown with dark grey patches, with longitudinal cracks; inner bark green, pale yellowish-brown or orange-brown, with longitudinal striations; sapwood pale yellowish-brown or orange-brown; latex white. Branches suberect, ascending or patent with the apical shoots ascending. *Twigs* slender, densely covered with reddish-brown stellate hairs which have arms up to 4 mm long. *Leaves* imparipinnate, up to 85 cm long and 65 cm wide; petiole 10–22 cm long, petiole, rachis and petiolules with indumentum like the twigs. *Leaflets* (5–)7–9, (4–)9–41 by (3–)4.5–11.5 cm, acuminate or caudate at apex, tapering to a cuneate or subcordate, asymmetrical base, with stellate hairs like those on the twigs on both surfaces but more frequent on the lower surface, sometimes white on young leaves, interspersed with smaller paler hairs which have fewer arms; veins (7–)8–23 on each side of the midrib; petiolules 2–7 (–40) mm. *Male inflorescence* up to 40 cm long and wide, with bracts up to 3 cm long on the rachis and up to 1.5 cm on the branches, with numerous stellate hairs; peduncle

up to 6 cm, peduncle, rachis and branches densely covered with hairs like those on the twigs. *Male flowers* minute, up to 1.2 mm in diam.; pedicels up to 2 mm, with numerous stellate hairs. *Calyx* with numerous stellate hairs. *Petals* 5 (or 6). *Staminal tube* nearly the length of the corolla, obovoid with a minute apical pore c. 0.2 mm across; anthers less than 1/4 the length of the tube, yellow when immature, brown at anthesis, turning black later, broadly ovoid, inserted in the uppermost 1/3 and included within the tube. *Female inflorescence* up to 6 cm long and wide, with fewer branches; peduncle up to 2 cm; the bracteoles more dense; *female flowers* fewer but slightly larger and arranged amongst the bracts, otherwise like the male. *Infructescence* with persistent bracts and up to 10 fruits. Young *fruits* c. 2 cm long and wide, subglobose, green, densely covered with often deciduous stellate hairs like those on the twigs, the longer arms often breaking off leaving a dense cluster of short arms; pericarp brittle, readily torn open, c. 1 mm thick, outer layer green, inner surface smooth, white and shiny. Locule 1, containing 1 *seed*. — **Fig. 42, 43.**

Distribution — *Malesia:* Peninsular Malaysia, Borneo.

Habitat — Found in primary forest; 100–250 m altitude.

Uses — Timber used for beams and fruit sweet and edible [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 75].

Fig. 43. *Aglaia rufibarbis* Ridley. Young fruit, covered with stellate hairs which have long arms. On the surrounding bracts individual stellate hairs are visible. Kuala Lompat, Pahang, Malaysia (*Pannell 1402*). Photograph C.M. Pannell, 1979.

Notes — 1. The indumentum of stellate hairs with long arms, up to 4 mm (which at first sight appear to be simple), is unmistakable. The twigs, rachis and both surfaces of the leaflets have an indumentum of reddish-brown or white stellate hairs which have very long, rather sharp arms up to 4 mm, hence the specific epithet *rufibarbis*.

2. The holotype bears a note stating that the fruit is edible and sweet, which suggests the presence of an aril surrounding the seed. The seed in the single mature fruit of this species seen by this author was unusual in having no fleshy outer layer: the aril and outer membraneous seed coat (?testa) were confined to a small area around the hilum, an inner membraneous seed coat (?tegmen) was thin and papery with the main vascular bundle running through the raphe and antiraphe and branching divaricately from the raphe over the sides of the seed.

LANSIUM

Lansium Correa, Ann. Mus. Nat. Hist. Nat. Paris 10 (1807) 157; T.D. Penn., Blumea 22 (1975) 483; Mabb., Blumea 31 (1985) 140. — *Aglaia* Lour. sect. *Lansium* (Correa) Kosterm., Reinwardtia 7 (1966) 221, p.p.

[*Plutea* Noronha, Verh. Bat. Genoot. ed. 5, 1 (1791) art. 4, 3, nom. nud.]

Trees to c. 30 m tall, often fluted and buttressed. *Indumentum* of simple hairs. *Leaves* pinnate, the leaflets subopposite to alternate, the most apical on one side appearing terminal and usually largest; secondary venation reticulate, conspicuous when dried; petiolules pulvinate at base; domatia absent. *Inflorescences* spikes, racemes or more rarely basally branched panicles with spicate or racemose branches, borne on twigs, branches or bole. *Flowers* unisexual (tree dioecious) and bisexual, the latter larger than male ones. *Calyx* deeply 5-lobed, the lobes imbricate. *Petals* 5, free from each other but united with staminal tube in proximal third to half, imbricate. *Staminal tube* globose to cyathiform, margin ± undulate; anthers (8–)10 in one whorl inside the throat of the tube, their tips not or slightly exserted, without appendages. *Disk* absent. *Ovary* 3–5-locular, each locule with one ovule; style long and broad-columnar, ± slightly expanded at the truncate stylehead, its flanks ribbed with the impressions of the surrounding anthers, pistillode more slender, ovules smaller. *Fruit* a 1–5-seeded berry with soft pericarp. *Seed* arillate (*L. breviracemosum* possibly exarillate), the aril thick, fleshy, white, edible, completely enveloping seed; embryo with thick plano-convex, superposed free cotyledons, radicle included.

Distribution — Three species, the genus possibly being the only one restricted to *Malesia*, but planting of *L. domesticum*, which may be native in southern Thailand in any case, elsewhere has obscured this.

Habitat — Rain forest, including kerengas, to 1360 m altitude.

Note — The venation of the leaflets closely resembles that of many *Sapindaceae*, notably *Lepisanthes* spp. (see further under Excluded species), and is also seen in *Aglaia* spp. (particularly *A. oligophylla* Miq.), *Chisocheton lansiifolius* Mabb., *C. sapindinus* Stevens and *Dysoxylum rigidum* (Ridley) Mabb.

KEY TO THE SPECIES

1a. Calyx lobes triangular, reflexed at anthesis, calyx tube continuous with pseudopedicel, 4–6 mm long, articulated with pedicel to 1.5 mm .. **1. L. membranaceum**
b. Calyx lobes orbicular to suborbicular, not reflexed at anthesis, calyx tube sessile or subsessile 2
2a. Fruit ellipsoid to globose, 2–4 cm long; infructescences borne on branches and bole, rarely on twigs ..... **2. L. domesticum**
b. Fruit globose, to 15 mm diam., infructescences borne on twigs .... **3. L. breviracemosum**

1. Lansium membranaceum (Kosterm.) Mabb.

Lansium membranaceum (Kosterm.) Mabb., Blumea 31 (1985) 141. — *Aglaia membranacea* Kosterm., Reinwardtia 7 (1966) 260.

Tree to 30 m; bole to 30 cm diam. Bark smooth to flaking, yellowish; inner bark ochreish yellow; sapwood light yellow. *Twigs* subglabrous except for finely sericeous buds, cicatrose, cicatrices scutellar to 5 mm diam. *Leaves* 25–30 cm long; petiole 3.5–8.5 cm, often flattened adaxially, pulvinate. *Leaflets* 2 or 3 on each side, alternate or subopposite, 10–13 by 5–6 cm, the most apical largest, to 21 by 10 cm, ovate to elliptical-obovate, chartaceous, glabrous; apex acuminate, acumen to 11 mm; base weakly asymmetric, cuneate; costae 8–10 on each side, arcuate; secondary venation reticulate, conspicuous on both surfaces when dry; petiolules 10–15 mm (to 20 mm in most apical leaflets). *Racemes* 12–19 cm, solitary or usually in fascicles of up to 5, borne on twigs bearing leafy shoots, sometimes at either side of the base of such shoots, or in axils of cicatrices, glabrous; bracts 1 mm; pedicels articulated, proximal segment to 1.5 mm, distal 4–6 mm. *Calyx* lobes c. 1 mm long, triangular, reflexed at anthesis, margin ciliate. *Petals* 2.5–3 mm long, suborbicular, glabrous. *Staminal tube* glabrous, margin undulate; anthers slightly protruding from tube. *Ovary* and style densely pilose. *Fruit* to 4 cm long, ellipsoid to subglobose, 1-seeded.

Distribution — *Malesia:* Sumatra. Known only from Mt Sago, C Sumatra and collected only three times.

Habitat — Rain forest, 800–1000 m altitude.

Note — Kostermans, l.c., mentions a fruit bought in a market in Padang, W Sumatra and considers that it may belong here. It had a thin very acid aril.

2. Lansium domesticum Correa

Lansium domesticum Correa, Ann. Mus. Nat. Hist. Nat. Paris 10 (1807) 157, t. 10, f. 1. agg.; Marsd., Sumatra (1811) 101, t. 7 ('1813'); Poir. in Lam., Encycl. Méth. Bot. Suppl. 3 (1813) 299; Jack, Trans. Linn. Soc. 14 (1823) 115, t. 4, f. 1, incl. var. *aqueum* Jack; Blume, Bijdr. (1825) 165; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 233; Hassk., Cat. Hort. Bogor. (1844) 220; Jack, Calc. J. Nat. Hist. 4 (1844) 188, t. 16, incl. var. *aqueum*; Blanco, Fl. Filip. ed. 2 (1845) 228; M. Roem., Synops. Monogr. 1 (1846) 99; D. Dietr., Syn. 4 (1847) 788; Miq., Fl. Ind. Bat. 1, 2 (1859) 545; Suppl. (1860/61) 54, 197, 508; Hoola van Nooten, Fl. Fr. Java (1863) t. [8]; Miq.,

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 33; Hiern in Hook. f., Fl. Brit. India 1 (1875) 558; C.DC. in DC., Monogr. Phan. 1 (1878) 598; Blanco, Fl. Filip., ed. 3, 2 (1878) 62; Fern.-Vill., Nov. App. (1880) 43; Warb., Bot. Jahrb. 13 (1891) 344; King, J. As. Soc. Beng. 64, ii (1895) 81; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 162, f. J & P; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 180, incl. var. *pubescens* Koord. & Valeton; Wray, Perak Mus. Notes 2 (1897) 30; Prinsen Geerl., Chem. Ztg 21 (1897) 719; Becc., For. Born. (1902) 598; Ridley, Agr. Bull. Str. Fed. Mal. St. 1 (1902) 429; Bland, Agr. Bull. Str. Fed. Mal. St. 1 (1902) 590; Hochr., Pl. Bogor. Exsicc. (1904) 74 n. 159, incl. var. *pubescens*; Merr., Philipp. Govt. Lab. Bur. Bull. 27 (1905) 31; Brandis, Indian Trees (1906) 144; Backer, Fl. Batavia 1 (1907) 278, incl. var. *pubescens* & var. *typicum* Backer ('*typica*'), nom. superfl.; Schoolfl. Java (1911) 215, incl. varieties; Merr., Fl. Manila (1912) 275; Koord., Exk. Fl. Java 2 (1912) 443, incl. var. *pubescens*; Pratt et al., Phil. J. Sc. Chem. Geol. 8 (1913) 80, t. 14 f. 1; Gleason, Torreya 15 (1915) 118, t. 1; Anon., U.S. Dept. Agr. Bur. Pl. Ind. Inv. Seeds & Pl. Imp. 33 (1915) 18, 26, t. 3, 4; Webster, Philipp. Agr. Rev. 8 (1915) 105, t. 6, 9a; Merr., Interpr. Rumph. (1917) 309; Crev. & Lem., Cat. Prod. Indoch. 1 (1917) 228; Merr., Sp. Blanc. (1918) 211; Philipp. Agr. Rev. 13 (1920) 181, t. 18A; Popenoe, Man. Trop. Fr. (1920) 426, t. 54; Merr., Enum. Born. Pl. (1921) 320; Mendiola, Philipp. Agr. 11 (1922) 117; Ridley, Fl. Malay Penins. 1 (1922) 411, incl. var. *pubescens*; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 368; Webster, Philipp. Bur. Agr. Bull. 39 (1924) 113; Mendiola, Man. Pl. Breed. Trop. (1926) 262; Craib, Fl. Siam. Enum. 1 (1926) 259; Ochse, Ind. Vruchten (1927) 120, t. 58–60; Merr., Univ. Calif. Publ. Bot. 15 (1929) 123, incl. *Lansium sp.*; Burkill & Haniff, Gard. Bull. Sing. 6 (1930) 183; Valenz. et al., Nat. Appl. Sc. Bull. Univ. Philipp. 1 (1930) 71; Ochse, Fr. Cult. Dutch E. Ind. (1931) 61, t. 24, 25, incl. var. *pubescens* & var. *typicum*; Bailey, Stand. Cycl. Hort. 2 (1933) 1818; Berg. & Mull., Pharm. Zent. 74 (1933) 741; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1314; Briq., Mém. Inst. Nat. Genev. 24 (1935) 69; Elmer, Leafl. Philipp. Bot. 9 (1937) 3383; Guevara, Rev. Filip. Med. Farm. 31 (1940) 145; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 30, f. J–P; Corner, Wayside Trees 1 (1940) 463; Merr., Pl. Life Pac. World (1946) 94, 154, t. 204; Adelb., Blumea 6 (1948) 319; Steenis, Fl. Scholen Indon. (1949) 234; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 895; Quisumb., Med. Pl. Philipp. (1951) 480; Merr., J. Arnold Arbor. 33 (1952) 229; Steenis-Kruseman, Org. Sc. Res. Indon. Bull. 18 (1953) 34; Bernardo et al., Philipp. Agr. 43 (1959) 375; Hô & Duong, Fl. Vietnam (1960) 248, 1.90D; Kosterm., Reinwardtia 5 (1960) t. 13 p.p.; Ochse et al., Trop. Subtrop. Agr. 1 (1961) 644, t. 111; Bernardo et al., Philipp. Agr. 44 (1961) 415; Anon., Wealth India 6 (1962) 30, t. 17; Backer & Bakh. f., Fl. Java 2 (1965) 125, incl. var. *pubescens*; Molesw. Allen, Mal. Fr. (1967) 100, t. 36; T.D. Penn., Blumea 22 (1975) 484, t. 9g, h; Corner, Seeds Dicots 1 (1976) 190, 2 (1976) t. 386; Panggabean, Bull. Kebun Raya 2 (1976) 229, cum tab.; L.M. Perry, Med. Pl. E. & SE. Asia (1980) 261; Chin & Yong, Malays. Fr. Col. (1981) 31, cum tab.; Rao & Koth., J. Pl. Anat. Morph. 1 (1984) 102; Phillips et al., Guide Market Fr. SE. As. (1985) 66; Mabb., Blumea 31 (1985) 141; Polunin, Pl. Fl. Sing. (1988) t. 144; Corner, Wayside Trees, ed. 3 (1988) 501; Mabb. in Tree Fl. Malaya 4 (1989) 246; Hô, Ill. Fl. Vietnam 2, 1 (1992) 495, incl. 'var. langsat Jack'. — *Lachanodendron domesticum* Nees, Flora 8 (1825) 103, nom. nud., laps. pro *Lansium domesticum*. — *Aglaia domestica* (Correa) Pellegr. in Fl. Indo-Chine 1 (1911) 766, nom. illeg. (*Baccaurea sylvestris* Lour. in syn.); Bois Pl. Aliment. 2 (1928) 101, cum tab.; Kosterm., Reinwardtia 7 (1966) 244; Guzman et al., Guide Philipp. Fl. Pl. 3 (1986) 334, t. 254.

Lansium aqueum (Jack) M. Roem., Synops. Monogr. 1 (1846) 99; Miq., Fl. Ind. Bat. 1, 2 (1859) 545; Suppl. (1861) 197; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 34; C.DC. in DC., Monogr. Phan. 1 (1878) 598; Kosterm., Reinwardtia 5 (1960) 351, t. 13, p.p. — *Aglaia aquea* (Jack) Kosterm., Reinwardtia 7 (1966) 234, t. 4.

Lansium javanicum M. Roem., Synops. Monogr. 1 (1846) 99.

Aglaia dookoo Griff., Notul. 4 (1854) 505; Kosterm., Reinwardtia 7 (1966) 238, t. 5a, b; de Vogel, Seedlings Dicots (1990) 344, f. 124.

Lansium javanicum Koord. & Valeton ex Mol! & Janss., Mikrogr. Holzes 2 (1911) 176, non M. Roem.; Koord.-Schum., Syst. Verz. 1 (1) Fam. 140 (1912) 31.

Amoora racemosa Ridley, J. Fed. Mal. St. Mus. 10 (1920) 88; Craib, Fl. Siam. Enum. 1 (1926) 261.

Taeniochlaena polyneura Schellenb., Bot. Jahrb. 59, Beibl. 131 (1924) 24; in Engl., Pflanzenr. 103 (1938) 169; cf. Leenh., Fl. Males. I, 5 (1958) 510.
[*Aglaia merrillii* Elmer, Leafl. Philipp. Bot. 9 (1937) 3298, nom. illeg., descr. angl.]
Lansium pedicellatum Kosterm., Reinwardtia 7 (1965) 31, t. 11, non Hiern (1875).
Lansium sepalinum Kosterm., Reinwardtia 7 (1965) 31, t. 12. — *Aglaia sepalina* (Kosterm.) Kosterm., Reinwardtia 7 (1966) 258, t. 11.
?*Aglaia intricatoreticulata* Kosterm., Reinwardtia 7 (1966) 259, t. 12.
Aglaia steenisii Kosterm., Reinwardtia 7 (1966) 232, t. 2.
Lansium parasiticum Sahni & Bennet, Ind. For. 100 (1974) 202, excl. basion., incl. var. *aqueum* (Jack) Sahni & Bennet ('*L. paraciticum* var. *aequem*').
[*Lance* Bontekoe, Hist. Nat. Med. Ind. Or. 6 (1658) 109.]
[*Boboa seu Lanzones* Kamel in Ray, Hist. Pl. 3, App. Herb. Luz. Philipp. (1704) 56.]
[*Lansium* Rumph., Herb. Amb. 1 (1741) 151, t. 54.]
Lansones Blanco, Fl. Filip. (1837) 326.

Tree to 30 m and 75 cm diam. but usually much less. Bole irregularly fluted; buttresses short, concave, to 2 m out. Bark light reddish brown or fawn mottled, slightly scaling and with tubercles of old infructescences. *Twigs* subglabrous to ± tomentellous when young. *Leaves* 30–50 cm; petiole 5–8 cm, often flattened adaxially, pulvinate. *Leaflets* 2–4(–5) on each side, alternate or subopposite, 9–25(–45) by 5–10(–15) cm,

Fig. 44. *Lansium domesticum* Correa. 'Langsat' as purchased in the market at Kajang, Selangor, West Malaysia. Photograph D.J. Mabberley, August 1974.

Fig. 45. *Lansium domesticum* Correa. a. Leafy shoot; b. inflorescence; c. half flower; d. staminal tube, from inside and outside; e. infructescences; f. fruit, transverse section; g. seed (a: *FRI 5405* and *KEP 13338*; b–d: *Soepadmo s.n.*; e–g: *Pennington 7885*). Drawing R. van Crevel.

the most apical usually the largest, elliptical-ovate to oblong, coriaceous, glabrous adaxially, subglabrous to fawn-tomentose adaxially, especially on venation; apex shortly acuminate, acumen 10–15(–25) mm; base ± asymmetric, acute to cuneate; costae (7–) 10–14 on each side, arcuate; venation reticulate to scalariform, conspicuous on both surfaces when dry; petiolules 5–10 mm, ± pubescent. *Racemes* 4–20 cm, sweetly scented, solitary or usually in fascicles of mature and immature (c. 1–2 cm), borne on branches and bole, rarely on twigs, ± pubescent; bracts c. 1 mm, ovate, acute; pedicels 0–2 mm. *Calyx* lobes 1–2 mm diam., suborbicular, margin ciliate. *Petals* 2–3 mm long, ovate to suborbicular, creamy white. *Staminal tube* glabrous or almost so, margin undulate to crenate; anthers 1–2 mm, within or slightly protruding from tube. *Ovary* and style densely pilose. *Fruit* 2–4 cm long, 1.5–2(–4) cm diam., pale yellow or brownish, often becoming glabrous; pericarp sometimes with white latex, white within. *Seeds* 1–5, the locules with undeveloped seeds filled with arillate tissue; aril completely enveloping seed, c. 25 mm long, 15 mm wide, perichalazal and pachychalazal, developing from funicle and exostome (Corner, Seeds Dicots), testa c. 13 mm long, 7 mm wide, ± flattened ellipsoid. Seedlings with simple leaves. 2n = 144. — **Fig. 44, 45.**

Distribution — Peninsular Thailand; *Malesia* (wild, cultivated and naturalized): Sumatra, Malay Peninsula, Borneo, Java, Philippines (?native), Celebes (?native), Moluccas (?native), West New Guinea (?native). Cultivated in Indochina, India, Florida etc.

Habitat & Ecology — Rain forest including kerengas and on limestone, 0–110 m altitude. According to Whitmore [Trop. Rain For. Far East (1975) 237], the trees are very scattered occurring with a density of 0.2 trees per 40 ha of forest in Ulu Kelantan, Malay Peninsula. Fruit said to be dispersed by bats. An analysis of the defence compounds in the bark (phenolics and condensed tannins) is provided by Whitten & Whitten, Biotropica 19 (1987) 113 ('*Aglaia dookoo*').

Vernacular names — Known throughout the archipelago as langsat, lansat, lansch, lantjat, lasa or other variants such as lanzon in the Philippines. Different cultivars are known as bidjitan, duku, kokessan, pisitan (Sund.), tjeloreng, tjeloring (Jav.). Other names I have not seen on herbarium material are recorded by Merrill [Enum. Philipp. Flow. Pl. 2 (1923) 368] for the Philippines and K. Heyne [Nutt. Pl. Indon., ed. 3 (1950) 895] for Indonesia.

Uses — *Lansium domesticum* is one of the important native fruit trees of Malesia but it is scarcely grown on a plantation scale, most of the fruits seen in markets being collected from village trees. Forms have been in cultivation for a long time, those in Java in 1413 being remarked on by the Chinese traveller Ma Huan [Groeneveldt, Verh. Batav. Genoot. 39 (1877) 49]. In Java, there are three major recognized sorts: duku with small ellipsoid, glabrous, pale yellow fruits without latex from trees with glabrous leaves and small flowers; bidjitan or langsat with larger ellipsoid, glabrescent pale yellow fruits with a little latex from trees with larger flowers and leaves which are ± pilose abaxially; kokossan with smaller globose, orange yellow fruits with latex and a tough pericarp from trees with the largest flowers and most pubescent leaves [Kostermans, Reinwardtia 7 (1966) 243].

In the Malay Peninsula, the kokossan is rarely grown and, as far as I know, does not appear in major markets: the individual seeds are not removed, the juice of the aril merely

being sucked out from the bitten fruit, the flavour being like that of *Baccaurea motleyana* Muell.Arg. (*Euphorbiaceae*) (Kostermans, 1966: 236). The fruits in Malay markets are called duku and langsat and more recently has appeared duku-langsat. The name duku is used for a larger round form, which is borne in infructescences of about 8–12. The pericarp is always c. 5 mm thick without latex. Usually there are no developed seeds and the aril is sweetly flavoured. By contrast the langsat of the Malay Peninsula has smaller ellipsoid bitter-sweet fruits with thin pericarp and much latex, borne in inflorescences of about 20 or more (Fig. 44). The duku-langsat has features of both. The Malayan duku is a tree with a densely leafy wide crown, reminiscent of the *Baccaurea* (rambai); the langsat is more scruffy in appearance with a more open crown [see Molesworth Allen, Mal. Fr. (1967) 100, t. 36, f. 3, 4], though Molesworth Allen (l.c. 104) reported duku trees with this habit in Perak.

Prakash et al. [Phytomorphology 27 (1977) 50] have shown that the Malayan duku and langsat are apomictic, the different forms thus being clones. In the Philippines, forms known as lanzones which resemble the duku and langsat clones of the Malay Peninsula, have been shown to be apomictic and parthenocarpic (Bernardo et al., op. cit. 1961). Wild trees in the Malay Peninsula have sourer, smaller fruits with latex: they are not readily grown outside the forest (Ng, pers. comm.). Selected trees are also naturalized, persisting long after the forest has grown back around abandoned cultivation.

Large-leaved forms have been collected in northern Sumatra and southern Thailand, but whether these are truly wild or relics of cultivation is unknown. Moreover, nothing is known of the embryology of any truly wild tree.

Kostermans [Reinwardtia 7 (1966) 232–259] has attempted a classification of the wild and cultivated trees, in which the well known Java clones have been accorded specific rank: kokossan = *Aglaia aquea*; bidjitan = *A. domestica*; duku (sensu Java) = *A. dookoo* (described from the Malay Peninsula!). Closely related wild trees have been either included with them or assigned to separate species (*A. steenisii*, *A. sepalina*, ?*A. intricatoreticulata*). It seems more appropriate to combine the range of apomictic clones and their allies into an aggregate species (Mabberley, ll.cc.). Hasskarl (l.c.) proposed the vernacular names as used in Java as subdivisions in *L. domesticum* and these could be taken as cultivar names. However, the confusion about what in Malaya is the most important group of cultivated trees, the duku, would make the application of such names inappropriate. Without considerable fieldwork and embryological study, the fixing of names into a cultivar nomenclature seems premature and is not formally adopted here. Nevertheless, the tree known as kokossan, with its distinctive foliage and large flowers, the *L. domesticum* var. *aqueum*, var. *pubescens* or *L. aqueum* of botanists, may be the most clearcut candidate for such treatment and would be written *Lansium domesticum* cv. Kokossan or *Lansium domesticum* 'Kokossan'. It is recorded from Kuala Lumpur, Singapore, Sumatra and Java.

Although refreshing, the arils of *Lansium domesticum* have one of the lowest vitamin C contents of any fruit grown in Malesia [Ylagan, Philipp. Agr. 44 (1961) 478; Abdullah & Ragab, Malays. Agr. J. 47 (1970) 420], c. 3.9 ± 0.9 mg per 100 g fruit, the highest being guava at 102.6 ± 15.9 mg per 100 g. The arils represent some 60%

of the fruit and may be preserved in syrup or candied as well as eaten fresh. They comprise 86.5% water [Anon. in Wealth of India 6 (1962) 30, t. 17] and the fruits do not keep well, though at lower temperatures they may last in good condition for about two weeks. The pericarp turns brownish and acidity increases but later falls again.

Trees are propagated by budding, cleft and side grafting and from seed, in which case they flower after about 15 years. The young inflorescences are visible many months before anthesis [Yap, Mal. For. 45 (1982) 29] and begin to develop when flowers of other inflorescences are already mature. In the Malay Peninsula Yap (l.c.) records that flowering takes less than a month in wild populations. The cultivated duku and langsat fruit twice a year there, but droughts cause a missed season (Molesworth Allen, l.c.: 104). Indeed, the trees cannot be grown in regions with great seasonality. Particular clones are associated with certain regions in the peninsula, e.g. duku and the Kesang District of Johore and the duku-langsat which comes mainly from Kota Baru in Kelantan and Belada near Kuala Trengganu [Loh in J.T. Williams et al., SE Asian plant genetic resources (1975) 47–52], while the langsat is more frequently cultivated in the north of the peninsula (Molesworth Allen, l.c.). Some especially good forms may be worth as much as a durian to their owners. Interesting details of trading the fruits and of folklore associated with them is provided by Kostermans (1966). See also Yaacob & Bamroongrugsa in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 186.

The wood is light-coloured and has been used for toolhandles, houseposts and rafters. Formerly, it was one of the woods used for 'baja', a teeth-blacking agent used by the Malays [Wray, Perak Mus. Notes 2 (1897) 36]. The bark is astringent and is of possible medical value, particularly in treating dysentery. An extract has been used as an arrow poison, for which the seeds, which are said to be anthelmintic, have also been used. The pericarp has been burnt as an insect repellent in Java and used dried in the treatment of diarrhoea and intestinal spasms, as well as malaria and other fevers [Elliott & Brimacombe, Med. Pl. G. Leuser Nat. Park (1985) 32]. The active principle appears to be a resin [see Guevara, Rev. Fil. Med. Farm. 41 (1940) 143].

Note — *Aglaia intricatoreticulata*, known only from inadequate fruiting material from the Malay Peninsula, is included with some hesitation. The leaflets are opposite.

3. **Lansium breviracemosum** Kosterm.

Lansium breviracemosum Kosterm., Bull. Bot. Surv. Ind. 7 (1965) 128; Mabb., Blumea 31 (1983) 143. — *Aglaia breviracemosa* (Kosterm.) Kosterm., Reinwardtia 7 (1966) 233.

Tree to 20 m, to 20 cm diam. Bark smooth to cracking; inner bark greenish or pale brown. *Twigs* subglabrous except for sericeous buds, often lenticellate. *Leaves* 25–30 cm long; petiole 4–5 cm long, minutely pubescent, somewhat pulvinate at base. *Leaflets* 3–5 on each side, alternate to subopposite, 5–15 by 3–7 cm, ovate to elliptical, chartaceous, glabrous; apex acute to acuminate; base weakly asymmetric, cuneate; major veins 7–10 on each side, arcuate; secondary venation conspicuous on both surfaces when dry; petiolules 1.5–2 cm. *Racemes* to 8 cm long, solitary or, usually, in fascicles

of up to 3, or basally branched panicles, borne on twigs in axils of cicatrices or either side of base of leafy shoots, minutely pilose; bracts 1 mm, pilose; pedicels articulated, proximal segment 1–3 mm long, distal merging into calyx (pseudopedicel), c. 1 mm long, pilose. *Calyx* lobes up to 1 mm long, orbicular, pilose. *Petals* 2–2.5 mm long, suborbicular, glabrous, white. *Staminal tube* glabrous, margin obscurely undulate; anthers slightly protruding from the tube. *Ovary* and style densely pilose, 3-locular. *Fruit* up to 15 mm diam., globose, minutely densely tomentose, greenish-grey in life with three sutures and apical mammilla. *Seeds* 1–3, to 10 mm long, 6 mm diam., ellipsoid, without aril (Kostermans, ll.cc.).

Distribution — *E Malesia:* Sumbawa and Flores.

Habitat — Rain forest, altitude 400–1000 m (Sumbawa), 1000–1360 m (Flores).

Vernacular name — Sumbawa: narab suai.

REINWARDTIODENDRON

Reinwardtiodendron Koord., Minah. (1898) 389; Suppl. Fl. NO. Celebes 1 (1918) 23, t. 8a–b; Harms in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 2 (1900) 37; op.cit., ed. 2, 19b1 (1940) 125; T.D. Penn., Blumea 22 (1975) 486, t. 10c; Mabb., Blumea 31 (1985) 144.

Lansium Correa sect. *Neolansium* Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 124.

Aglaia Lour. sect. *Lansium* (Correa) Kosterm., Reinwardtia 7 (1966) 221, p.p.

Trees to c. 30 m tall with fluting stems or buttresses. *Indumentum* of simple hairs. *Leaves* pinnate or unifoliolate, the leaflets alternate, the most apical on one side appearing terminal and often larger; petiolules often swollen; domatia frequently present. *Inflorescences* spikes or basally branched panicles of spikes. *Flowers* bisexual, yellow. *Calyx* deeply 5-lobed, the lobes orbicular, imbricate. *Petals* 5, free from each other but united with staminal tube at base. *Staminal tube* globose to ovoid, with an undulate to toothed margin; anthers 10 in 2 whorls of five, glabrous, the upper ones partly exserted, the lower alternating with the upper and completely included, their connectives extended to form a short acute appendage. *Disk* absent. *Ovary* 5-locular, each locule with one ovule; style very short, with a small capitate or pileate, obscurely lobed apex. *Fruit* a 1–5-seeded berry. *Seed* apparently sarcotestal; embryo with thick plano-convex, superposed, free cotyledons, radicle included.

Distribution — Probably seven species restricted to Indomalesia, one [*R. anaimalaiense* (Bedd.) Mabb.] restricted to the western Ghats of India, the rest occurring in *Malesia*. Three species are fairly widespread, the remaining three, apparently closely related, are rather restricted, one in northern Borneo, one in the Lesser Sunda Islands and the last, undescribed, in N Sumatra.

Habitat — Rain forest up to c. 900 m altitude.

Note — The genus consists of very closely related but clearcut, distinct species, some of which are very little known. It closely resembles *Aglaia* in pollen and secondary xylem as well as overall facies but it differs in its simple indumentum, the two whorls of anthers with appendages and the 5-locular ovary. It is perhaps closest to *Lansium* which

Fig. 46. *Reinwardtiodendron cinereum* (Hiern) Mabb. a. Flowering shoot; b. half flower; c. fruiting shoot. Drawing R. Wise. Reproduced (rearranged) with permission from Tree Flora of Malaya 4.

shares the indumentum and the leaflet form and venation but differs in its single whorl of 10 stamens without appendages, the ramiflorous to cauliflorous inflorescences and the seeds which are arillate and pachychalazal.

KEY TO THE SPECIES

1a. Leaves unifoliolate ..... **5. R. celebicum**
b. Leaves pinnate 2
2a. Secondary veins almost as prominent as primary, at least on adaxial surface ..... **4. R. humile**
b. Secondary veins not so prominent 3
3a. Adaxial surface of leaflet midrib brown tomentose ..... **1. R. cinereum**
b. Adaxial surface of leaflets glabrous 4
4a. Peduncles pilose. Domatia frequently present ..... **2. R. kinabaluense**
b. Peduncles glabrous. Domatia unrecorded ..... **3. R. kostermansii**

1. Reinwardtiodendron cinereum (Hiern) Mabb.

Reinwardtiodendron cinereum (Hiern) Mabb., Malays. For. 45 (1982) 452; Blumea 31 (1985) 144; in Tree Fl. Malaya 4 (1989) 247, f. 7A. — *Lansium cinereum* Hiern in Hook. f., Fl. Brit. India 1 (1875) 558; C. DC. in DC., Monogr. Phan. 1 (1878) 597; King, J. As. Soc. Beng. 64, ii (1895) 81; Ridley, Fl. Malay Penins. 1 (1922) 411. — *Aglaia pseudolansium* Kosterm., Reinwardtia 7 (1966) 252, t. 6.

Tree to 27 m, to 70 cm diam. and clear bole to 18 m. Buttresses to 1 m tall, extending out to 3 m, snake-like at extremities. Bark smooth with scaly patches and conspicuous knobbly tubercles; inner bark white; sapwood yellow. *Twigs* rather angular, with conspicuous leafscars and dense indumentum when young, aluminium grey later. *Leaves* 10–15 cm long; petiole 1.5–2 cm, petiole and rachis densely brown tomentose. *Leaflets* 2–4 (5) on each side, 4–5.5 (–8) by 1.5–2.5(–3.5) cm, the most

Fig. 47. *Reinwardtiodendron cinereum* (Hiern) Mabb. Fluted bole. West Malaysia, Pahang. Photograph D. J. Mabberley, July 1981.

apical larger, up to 11.5 by 4.5 cm, elliptical, chartaceous to subcoriaceous, very sparsely pubescent abaxially, midrib bristly brown pilose on both surfaces, major veins thus abaxially; apex acuminate, acumen to 6–8 mm long; base weakly asymmetric, cuneate; major veins c. 6–8 on each side, arcuate, with pilose domatia in their axils, secondary veins less conspicuous; petiolules c. 5 mm, densely brown tomentose, weakly swollen at base. *Spikes* to 10 cm; peduncles densely pilose; bracts to 4 mm long, acute, often with smaller bracteoles. *Calyx* lobes c. 1 mm long, fawn sericeous, the margin ciliate. *Petals* 4 mm long, ovate. *Fruit* 1.5–2 cm diam., globose, glabrous, yellow. — **Fig. 46, 47.**

Distribution — *W Malesia:* Sumatra, Malay Peninsula, and northern Borneo.

Habitat — Rain forest to 700 m altitude. Rarely collected.

Uses — The sarcotesta is edible.

Note — The leaflets are very similar to those of *Aglaia oligophylla* (q.v.) but are more or less opposite and have no stellate indumentum.

2. **Reinwardtiodendron kinabaluense** (Kosterm.) Mabb.

Reinwardtiodendron kinabaluense (Kosterm.) Mabb., Blumea 31 (1985) 145. — *Aglaia kinabaluensis* Kosterm., Reinwardtia 7 (1966) 253, t. 7.

Tree to 20 m, to 25 cm diam. and clear buttressed bole to 15 m. Bark smooth; inner bark yellow to white; sapwood yellow. Leafy *twigs* soon glabrous, adpressed pilose at apices. *Leaves* to 27 cm; petiole 4–5 cm, sparsely pubescent to glabrous. *Leaflets* 1 or 2 on each side, the leaves thus largely trifoliolate, 8–15 by 3–6.5 cm, the most apical usually the largest (to 18 by 7 cm), oblong-elliptic, chartaceous to subcoriaceous, glabrous; apex acuminate, acumen to 18 mm long; base cuneate; major veins c. 7 on each side, arcuate, frequently with small domatia in their axils, secondary veins less conspicuous; petiolules c. 5 mm, sulcate, swollen at base. *Spikes* to 8 cm long or basally branched panicles with 2 or 3 branches to 8 cm long; peduncles more or less pilose especially in high altitude specimens; bracts 1 mm long, triangular, pilose. *Calyx* lobes c. 1.5 mm long, more or less pilose, margin ciliate. *Petals* 4–5 mm long, ovate. *Fruits* to 5 cm long, depressed-globose when young, obovoid with apical depression and 5 ribs when mature, sericeous, yellow.

Distribution — *W Malesia:* northern Borneo.

Habitat — Rain forest to 900 m altitude. Rarely collected.

Note — This species is remarkably similar in overall facies to *Aglaia oligophylla* Miq. though the leaflets are larger in that species and the indumentum of stellate hairs, best seen in the fruit, distinguishes it at once. Furthermore, domatia are absent.

3. **Reinwardtiodendron kostermansii** (Prijanto) Mabb.

Reinwardtiodendron kostermansii (Prijanto) Mabb., Blumea 31 (1985) 145. — *Lansium kostermansii* Prijanto, Reinwardtia 8 (1965) 63, t. 1a, b. — *Aglaia kostermansii* (Prijanto) Kosterm., Reinwardtia 8 (1966) 256, p.p., t. 9.

Tree to 30 m, 40 cm diam. Bole fluted at base. Bark smooth, yellowish; inner bark yellowish. Leafy *twigs* soon glabrous, adpressed pilose at apices. *Leaves* 15–20 cm long; petiole 3–4.5 cm long, very sparsely and minutely puberulous. *Leaflets* 1–3 on each side, the leaves mostly 3- or 5-foliolate, 6.5–11 by 3–5 cm, oblong-elliptic, chartaceous to subcoriaceous, glabrous except for minutely puberulent abaxial surface of lamina and especially midribs and petiolules; apex acuminate, acumen to 9 mm, base acute to cuneate; major veins 7–10 on each side, arcuate; secondary veins less prominent; petiolule c. 5 mm, somewhat channelled when dry, weakly swollen at base. *Inflorescences* spikes 11–18 cm long, axillary to slightly supra-axillary; rachis glabrous; bracts c. 0–5 mm long, triangular, pubescent. *Calyx* lobes c. 1 mm long, orbicular, glabrous, margin weakly ciliate. *Petals* c. 3.5 mm long, ovate. *Fruits* to 3 cm diam., globose, weakly dimpled at apex, obscurely 5-ribbed, velutinous, yellow. *Seeds* (fide Kostermans) 1–3 developing, 1.5–2.5 cm long, 1.5–2 cm diam.

Distribution — *E Malesia:* W Sumbawa and W Flores.

Habitat — Lowland to submontane rain forest, 200–500 m altitude; common in relict patches of valley forest.

Vernacular names — Kaju (= tree) narab (Sumbawa); garu (Flores).

Uses — The sarcotesta is edible.

4. **Reinwardtiodendron humile** (Hassk.) Mabb.

Reinwardtiodendron humile (Hassk.) Mabb., Mal. For. 45 (1982) 452; Blumea 31 (1985) 145; in Tree Fl. Malaya 4 (1989) 249, f. 7B. — *Lansium humile* Hassk., Retzia, ed. nov. 1 (1858) 121; Miq., Fl. Ind. Bat. 1, 2 (1859) 545; Suppl. (1861) 197; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 34; C.DC. in DC., Monogr. Phan. 1 (1878) 598; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 183; Hochr., Pl. Bogor. Exsicc. (1904) 74; Backer, Schoolfl. Java (1911) 215; Koord.-Schum., Syst. Verz. 1 (1911) 30; Koord., Exk. Fl. Java 2 (1912) 443; Backer & Bakh. f., Fl. Java 2 (1965) 125. — *Aphanamixis humilis* (Hassk.) Kosterm., Reinwardtia 7 (1966) 263 ('*humile*'); Backer & Bakh. f., Fl. Java 3 (1968) 654.

Lansium dubium Merr., Philipp. Govt. Lab. Bur. Bull. 17 (1904) 23; Brown, Bull. Dept. Agr. Bur. For. Philipp. 21 (1920) 82, t. 40; ibid. 22 (1921) 304, t. 40; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 368; Webster, Bull. Dept. Agr. Bur. Agr. Philipp. 39 (1924) 125; Elmer, Leafl. Philipp. Bot. 9 (1937) 3384; Li, J. Arnold Arbor. 25 (1944) 208; How & Chen, Acta Phytotax. Sin. 4 (1955) 27; Anon., Fl. Hainan 3 (1974) 67, t. 569. — *Aglaia dubia* (Merr.) Kosterm., Reinwardtia 7 (1966) 254; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 335. — *Reinwardtiodendron dubium* (Merr.) X.M. Chen, J. Wuhan Bot. Res. 4 (1986) 183.

Lansium sp.: Merr., Lingn. Sc. J. 5 (1927) 104.

Tree to 27 m, to 40 cm diam. Buttresses to 4 m tall, at apex running into fluted bole, at base running out to 5 m from tree (Kostermans). Bark smooth with scaly patches, fawn; inner bark yellow to reddish brown; sapwood yellowish. *Twigs* weakly cicatrose and subglabrous except minutely pubescent apices, drying dark brown. *Leaves* 15–20 cm long; petiole 2–4 cm long. *Leaflets* 2 or 3 on each side, (6–)8.5–10 by 1.8–3.5 cm, the most apical larger, up to 18 by 6.5 cm, elliptical to elliptical-obovate, chartaceous to subcoriaceous, glossy on both surfaces, ± glabrous; apex markedly acuminate, acumen to 1.5 cm long; base weakly asymmetric, cuneate; major veins not clearly distinct from secondary ones, particularly adaxially, together some 20–30 on each side,

parallel, straight, at about 60° to midrib, anastomosing at margin, prominent on both surfaces, rarely with domatia in axils adaxially; petiolules c. 4–6 mm long, weakly swollen and channelled. *Spikes* or panicles to 15 cm; peduncles very sparsely pubescent; bracts 2 mm long, acute, usually with a pair of smaller bracteoles, all sparsely pubescent. *Calyx* lobes 1–2 mm long, orbicular, margin ciliate. *Petals* to 2.5 mm long,

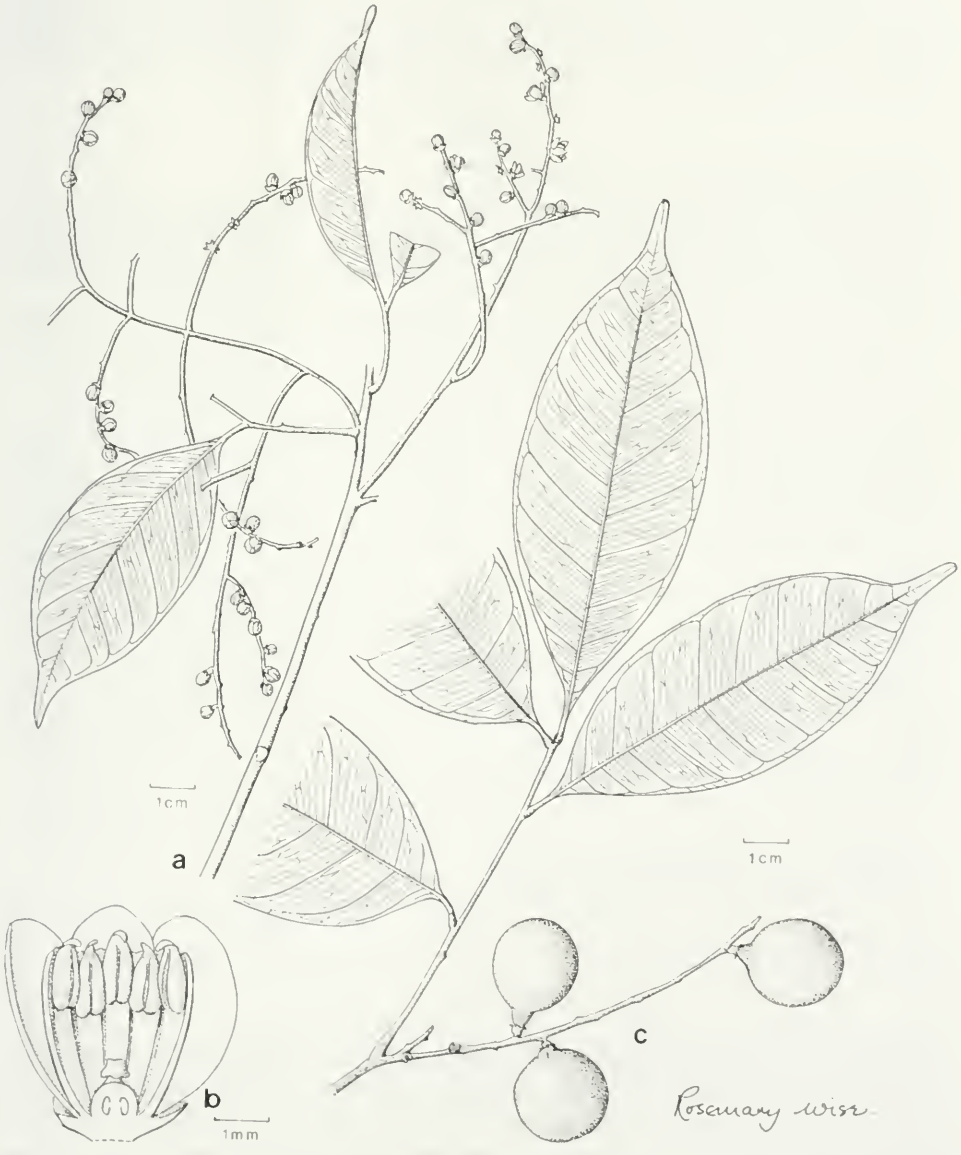

Fig. 48. *Reinwardtiodendron humile* (Hassk.) Mabb. a. Flowering shoot; b. half flower; c. fruiting shoot. Drawing R. Wise. Reproduced (rearranged) with permission from Tree Flora of Malaya 4.

yellow, ovate to obovate. *Fruit* to 5 cm diam., ± fig-shaped or obovoid, especially when immature, with apical depression and five sutures, densely but very shortly pilose, yellow. — **Fig. 48.**

Distribution — Hainan, Indochina; *Malesia:* Sumatra, Malay Peninsula, Borneo, Java, Philippines and SE Celebes.

Habitat — Rain forest to 800 m altitude.

Vernacular names — Tembangan, tipis kulit (Java); bintangor (Borneo); aragnan, malakanasi (fide Merrill), uban-uban (Bik.), bulahan (P. Bis.), tulanan (S.L. Bis.), bisik, buahan (Sul.), official common name: lansones-bundok (Philippines).

Note — The commonest and most variable species.

5. **Reinwardtiodendron celebicum** Koord.

Reinwardtiodendron celebicum Koord., Minah.(1898) 389; Suppl. Fl. NO. Celebes 1 (1918) 23, t. 8a–b; Koord.-Schum., Syst. Verz. 3 (1914) 63; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 369; Steenis, Nova Guinea, n.s. 10 (1959) 210, t. 2; Mabb., Blumea 31 (1985) 145. — *Aglaia reinwardtiana* Kosterm., Reinwardtia 7 (1966) 230, t. 1.

Reinwardtiodendron merrillii Perkins, Fragm. Fl. Philipp. (1904) 74; Merr., Philipp. J. Sc. 1, Suppl. (1906) 72; Elmer, Leafl. Philipp. Bot. 9 (1937) 3385.

[*Lansium monophyllum* Merr. ex Perkins, Fragm. Fl. Philipp. (1904) 75, nom. in syn.]

Tree to 25 m, to 40 cm diam., fluted. Buttresses to 1.75 m tall, extending out to 1.5 m. Bark smooth to scaling, light brown, thin; inner bark white; sapwood yellow; heartwood yellow-brown. *Leaves* unifoliolate, 14–25.5 by 5–8 cm; elliptic or weakly ovate or obovate, subcoriaceous, almost glabrous; apex acuminate; base cuneate; major veins 5–9 on each side, arcuate usually with hollow setose domatia in axils, prominent like midrib abaxially, both sunken adaxially (in sicco); secondary venation reticulate, prominulous on both surfaces; petiole 1–4.5 cm, surmounted by swollen petiolule c. 3 mm. *Spikes* or basally branched panicles, sometimes on short shoots and superficially resembling larger panicles, to 12 cm long; peduncles subglabrous; bracts triangular, weakly pilose, c. 1 mm long; bracteoles c. 1 mm long, adpressed to calyx. *Calyx* lobes c. 1 mm long, ± glabrous. *Petals* c. 3.5 mm long, ovate. *Fruit* to 3 cm diam., subglobose, densely shortly pilose with thin hard pericarp, without sutures, 1-seeded.

Distribution — *Malesia:* E Borneo, Philippines, Celebes, Moluccas, W New Guinea.

Habitat — Rain forest to 600 m altitude.

Vernacular names — Balbisan, bianti, malakamanga (Philippines), sakogwa, tam (New Guinea).

INSUFFICIENTLY KNOWN SPECIES

One collection from northern Sumatra probably represents a sixth species in the region. See Mabberley, Blumea 31 (1985) 146. The flowers are unknown but the fruiting specimens differ from *Reinwardtiodendron celebicum* in having pinnate leaves, from *R. cinereum* and *R. kinabaluense* (and *R. anaimalaiense*) in having no domatia, from *R. humile* in not having the very conspicuous secondary veins and from *R. kostermansii*, to which it seems most closely allied, in its conspicuously ribbed velutinous fruit.

Tribus Melieae

Melieae DC., Prodr. 1 (1824) 619; T.D. Penn., Blumea 22 (1975) 462.

Trees. *Indumentum* of stellate and/or simple hairs. *Leaves* pinnate or bipinnate. *Flowers* hermaphrodite or male. *Staminal tube* cylindrical, lobed. *Disk* annular. *Pistil* with 3–8-lobed stylehead. *Fruit* a drupe. *Seed* exarillate; endosperm thin; cotyledons collateral; radicle superior, exserted.

Two genera, in the wild state restricted to the Old World Tropics.

MELIA

Melia L., Sp. Pl. 1 (1753) 384; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 99, t. 26, 27; T.D. Penn., Blumea 22 (1975) 463, t. 4; Mabb., Gard. Bull. Sing. 37 (1984) 463. — [*Zederachia* Heist. ex Fabr., Enum. Meth. Pl. (1759) 221, nom. superfl. — *Azedarac* Adans., Fam. 2 (1763) 342, nom. superfl. — *Azedara* Raf., Fl. Ludov. (1817) 135, nom. superfl. — *Azedaraca* Raf., Med. Fl. 2 (1830) 199, nom. superfl.]
Azedarach Mill., Gard. Dict., Abr. ed. 4 (1754) [170].
Antelaea Gaertn., Fruct. Sem. Pl. 1 (1788) 277.

Trees, occasionally flowering precociously as shrublets. *Indumentum* of simple and stellate-tufted hairs. *Leaves* 2(–3)-pinnate. *Inflorescence* thyrsoid, axillary. *Flowers* hermaphrodite and male on same tree (polygamous). *Calyx* 5- (or 6-)lobed to near base, lobes somewhat imbricate. *Petals* 5 (6), free, imbricate. *Staminal tube* narrowly cylindrical, slightly expanded at mouth, 10- (or 12-)ribbed, with 10 or 12 truncate, bifid or 4-fid filiform lobes; anthers 10 (12), inserted at margin of or just within tube, alternating with or opposite lobes. *Disk* small, surrounding base of ovary. *Ovary* 4–8-locular, each locule with 2 superposed ovules; stylehead capitate to coroniform with 4–8 short, erect or incurved stigmatic lobes. *Drupe* 3–8-locular; endocarp thick, bony, deeply dimpled at base and apex; locules 1- (or 2-)seeded. *Seed* oblong, laterally compressed; testa leathery, sometimes slightly swollen and fleshy around hilum; embryo embedded in oily endosperm; cotyledons flat. Germination phanerocotylar; cophylls opposite, pinnatisect or trifoliolate. 2n = 28.

Distribution — One species in Indomalesia with one or possibly two closely allied ones in south tropical Africa. Forms of the Indomalesian species are widely cultivated and naturalized throughout the warm parts of the world.

Habitat — Forests of various types, the cultivated species also escaping in open secondary vegetation.

Notes — 1. As noted by Corner [Wayside Trees 1 (1940) 464], the inflorescences of cultivated *Melia azedarach* in Malaya are short shoots with terminal buds. The true inflorescences are borne in the axils of rudimentary leaves and after fruit abscission, the terminal bud may grow out into a leafy shoot. Similar short shoots are known to bear the inflorescences in *Chisocheton* (q.v.) while in South American species of *Guarea*, notably *G. kunthiana* A. Juss. [T.D. Penn., Fl. Neotrop. 28 (1981) 8], there being no sign of rudimentary leaves, the shoots are termed indeterminate inflorescences which grow

for some months, bearing ripe fruits at the base and young flowers at the apex, as figured by Pennington (op.cit. t. 59) for *G. pubescens* (Rich.) A. Juss.

2. For details of embryology, see Nair, J. Ind. Bot. Soc. 38 (1959) 367 et seq.

Melia azedarach L.

Melia azedarach L., Sp. Pl. (1753) 384, incl. var. *sempervirens* L.; Burm. f., Fl. Ind. (1767) 101; DC., Prodr. 1 (1824) 621; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 219, t. 13, f. 4; Blanco, Fl. Filip. (1837) 345 ('*acedarach*'); Hassk., Cat. Pl. Bogor. (1844) 219; M. Roem., Synops. Monogr. (1846) 94; Miq., Fl. Ind. Bat. 1, 2 (1859) 533; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 24, incl. var. *subtripinnata* Miq.; ibid. 4 (1868) 5, incl. var. *incisa* Miq., var. *acuminatissima* Miq., var. *sambucina* (Blume) Miq.; Hiern in Hook. f., Fl. Brit. India 1 (1875) 544; C.DC. in DC., Monogr. Phan. 1 (1878) 451, incl. var. *glabrior* C.DC. (nom. superfl.), var. *australasica* (A. Juss.) C.DC., var. *squamulosa* C.DC.; Morren, Belg. Hort. 30 (1880) 176, cum tab., incl. var. *floribunda* (Carr.) Morren; Fern.-Vill., Nov. App. (1880) 41; Vidal, Sin. Atl. (1883) 20, t. 29 f. E; Bisschop Grev., Pl. Ned. Ind. (1883) 490; C.DC., Bull. Herb. Boiss. 2 (1894) 577, incl. var. *squamulosa* C.DC.; Sarg., Gard. For. 7 (1894) 92, t. 20, incl. var. *umbraculifera* Knox ex Sarg.; King, J. As. Soc. Beng. 64, ii (1895) 20 ('*azidarach*'); Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 160 f. A–L; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 12, incl. var. *javanica* Koord. & Valeton, var. *squamulosa* C.DC.; Pierre, Fl. For. Cochinch. 5 (1897) t. 356B, incl. var. *glandulosa* Pierre ('*Melia composita* var. *biglandulosa*' in ic.); Koord., Minah. (1898) 390; Bailey, Cycl. Amer. Hort. 2 (1900) 1001, t. 1387, incl. var. *umbraculiformis* Hort. ex Berck. & Bail.; Backer, Fl. Batavia 1 (1907) 267; Schoolfl. Java (1911) 202; Pellegr. in Fl. Indo-Chine 1 (1911) 727, t. 79, f. 1–6, incl. var. *cochinchinensis* (Pierre) Pellegr., var. *biglandulosa* Pierre; Merr., Fl. Manila (1912) 276; Koord., Exk. Fl. Java 2 (1912) 439; Mak., Bot. Mag. Tokyo 28 (1914) 34, incl. var. *japonica* (G. Don) Mak., nom. superfl., subvar. *semperflorens* (Mak.) Mak., subvar. *toosendan* (Sieb. & Zucc.) Mak., subvar. *intermedia* Mak. f. *albiflora* Mak.; Ridley, Fl. Malay Penins. 1 (1922) 384; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 360; Mak., J. Jap. Bot. 5 (1928) 20, incl. var. *toosendan* (Sieb. & Zucc.) Mak., var. *intermedia* (Mak.) Mak.; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1441; Briq., Mém. Inst. Nat. Genev. 24 (1935) 41, t. 2, f. 11, 12; Elmer, Leafl. Philipp. Bot. 9 (1937) 3384; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 26, f. A–L, t. 27; Corner, Wayside Trees 1 (1940) 464, 2 (1940) t. 137; Adelb., Blumea 6 (1948) 315; Rehd., Bibl. Cult. Trees Shrubs (1949) 387, incl. f. *umbraculifera* (Sarg.) Rehd.; Steenis, Fl. Scholen Indon. (1949) 233; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 889; Quisumb., Med. Pl. Philipp. (1951) 482; Nair, J. Ind. Bot. Soc. 38 (1959) 367; Backer & Bakh. f., Fl. Java 2 (1965) 120; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 404, cum tab.; Vaughan, Struct. Util. Oil Seeds (1970) 157, t. 82 A–D; T.D. Penn., Blumea 22 (1975) 461, t. 4, f. d; Corner, Seeds Dicots 1 (1976) 190; 2 (1976) t. 387; Henty, Bot. Bull. Lae 12 (1980) 103, t. 36; Mabb., Gard. Bull. Sing. 37 (1984) 55; Corner, Wayside Trees, ed. 3 (1988) 502, t. 149; Du Puy in Fl. Austral. 50 (1993) 298. — *Azederach deleteria* Medik., Geschl. Malv. (1787) 116. — [*Melia florida* Salisb., Prodr. (1796) 317, nom. superfl.] — *Azedara speciosa* Raf., Fl. Ludov. (1817) 35. — *Azedaraca amena* Raf., Med. Fl. 2 (1830) 199. — *Azedarach vulgaris* Gomez de la Maza, Rep. Méd.-farm. Havana 5 (1894) 296.

Melia commelini Medik., Bot. Beob. 1782 (1783) 164. — [*Azedarach commelini* Moench ex Steud., Nom. Bot., ed. 2, 1 (1840) 175, 2 (1841) 118 ('Medik.'), nom. in syn.]

Antelaea javanica Gaertn., Fruct. Sem. Pl. 1 (1788) 277, t. 58.

Melia sempervirens (L.) Sw., Prodr. Veg. Ind. Occ. (1788) 67; Hassk., Cat. Pl. Bogor. (1844) 219; M. Roem., Synops. Monogr. 1 (1846) 95; Backer, Fl. Batavia 1 (1907) 268; Schoolfl. Java (1911) 202; Koord., Exk. Fl. Java 2 (1912) 439; Adelb., Blumea 6 (1948) 315; Backer & Bakh. f., Fl. Java 2 (1965) 120. — *Azedarach sempervirens* (L.) Kuntze, Rev. Gen. Pl. 1 (1891) 109, incl. var. *glabrior* (C.DC.) Kuntze, var. *australasica* (A. Juss.) Kuntze & var. *dubia* (Cav.) Kuntze.

Melia dubia Cav., Diss. 7 (1789) 364, ?nom. provis.; M. Roem., Synops. Monogr. 1 (1846) 96; Hiern in Hook. f., Fl. Brit. India 1 (1875) 545; C.DC. in DC., Monogr. Phan. 1 (1878) 453; Fern.-Vill., Nov. App. (1880) 41; Backer, Schoolfl. Java (1911) 201; Merr., Enum. Philipp. Flow. Pl. 2 (1923)

360; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1443; Briq., Mém. Inst. Nat. Genev. 24 (1935) 44; Elmer, Leafl. Philipp. Bot. 9 (1937) 3384; Adelb., Blumea 6 (1948) 315; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 889; Quisumb., Med. Pl. Philipp. (1951) 485; Backer & Bakh. f., Fl. Java 2 (1965) 120; Corner, Seeds Dicots 1 (1976) 191, 2 (1976) t. 388; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 341, t. 260.

[*Azederach odorata* Noronha, Verh. Bat. Genoot., ed. 5, 1 (1791) art. 4, 5, nom. nud.]

Melia composita Willd., Sp. Pl. 2 (1799) 559; DC., Prodr. 1 (1824) 622; Blanco, Fl. Filip., ed. 2 (1845) 241; M. Roem. Synops. Monogr. 1 (1846) 94; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 5; Blanco, Fl. Filip., ed. 3, 2 (1878) 84, t. 420; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 9; Pierre, Fl. For. Cochinch. 5 (1897) t. 356A, incl. var. *cochinchinensis* Pierre; Koord., Exk. Fl. Java 2 (1912) 439; Ridley, Fl. Malay Penins. 1 (1922) 384.

Melia robusta Roxb., Hort. Beng. (1814) 33, nom. nud.; G. Don, Gen. Syst. 1 (1831) 680.

Melia superba Roxb., Hort. Beng. (1814) 33, nom. nud.; Fl. Ind., ed. Carey, 2 (1832) 396. — [*Melia argentea* Hiern in Hook. f., Fl. Brit. India 1 (1875) 545, sphalm. pro *Melia superba*.]

Melia arguta DC., Prodr. 1 (1824) 622; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 220; M. Roem., Synops. Monogr. 1 (1846) 96; Miq., Fl. Ind. Bat. 1, 2 (1859) 532; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 5; C.DC. in DC., Monogr. Phan. 1 (1878) 454.

Melia sambucina Blume, Bijdr. (1825) 162; Hassk., Cat. Pl. Bogor. (1844) 219; M. Roem., Synops. Monogr. 1 (1846) 95; Miq., Fl. Ind. Bat. 1, 2 (1859) 533; C.DC. in DC., Monogr. Phan. 1 (1878) 455; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 17. — *Azedarach sambucina* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 110.

Melia angustifolia Schum. & Thonn. in Schum., Beskr. Guin. Pl. (1827) 214.

Melia guineensis G. Don in Loud., Hort. Brit. (1830) 168; Gen. Syst. 1 (1831) 681.

Melia australis Sweet, Hort. Brit., ed. 2 (1830) 85; G. Don, Gen. Syst. 1 (1831) 680.

Melia candollei A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 239; Linnaea 6, lit. (1831) 111; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 220, 258; M. Roem., Synops. Monogr. 1 (1846) 95; Miq., Fl. Ind. Bat. 1, 2 (1859) 532; Ann. Mus. Bot. Lugd.-Bat. 4 (1868)5; C.DC. in DC., Monogr. Phan. 1 (1878) 456; Fern.-Vill., Nov. App. (1880) 41; Perkins, Fragm. Fl. Philipp. (1904) 30; Merr., Fl. Manila (1912) 276; Sp. Blanc. (1918) 209.

Melia australasica A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 239; Linnaea 6, lit. (1831) 111; Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 220, 258.

Melia japonica G. Don, Gen. Syst. 1 (1831) 680; C.DC. in DC., Monogr. Phan. 1 (1878) 457, incl. var. *albicans* C.DC.; Mak., Bot. Mag. Tokyo 18 (1904) 67, incl. var. *semperflorens* Mak.

[*Melia bukayun* Royle, Ill. Bot. Himal. (1835) 141, nom. nud.]

[*Melia flaccida* Zipp. ex Span., Linnaea 15 (1841) 182, nom. in syn.]

Melia toosendan Sieb. & Zucc., Abh. Akad. München 4, 2 (1843) 159.

Melia japonica Hassk., Cat. Pl. Bogor. (1844) 219, nom. illeg., non G. Don. — *Melia hasskarlii* K. Koch, Hort. Dendrol. (1853) 72.

Melia javanica M. Roem., Synops. Monogr. 1 (1846) 96.

Melia cochinchinensis M. Roem., op. cit. (1846) 95.

Melia orientalis M. Roem., l.c.

Melia tomentosa auct. non Roxb.: Miq., Fl. Ind. Bat. 1, 2 (1859) 532.

[*Melia chinensis* Sieb. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 23, nom. in syn.]

Melia birmanica Kurz, J. As. Soc. Beng. 43, ii (1874) 183; C.DC. in DC., Monogr. Phan. 1 (1878) 458; Bull. Herb. Boiss. 2 (1894) 577.

Melia bogoriensis Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 18; Hochr., Pl. Bogor. Exsicc. (1904) 74; Koord., Exk. Fl. Java 3 (1912) 359; Atlas 1 (1913) t. 81; Briq., Mém. Inst. Nat. Genev. 24 (1935) 43.

[*Zizipha candida Monspelliensium* Lobel., Stirp. (1576) 546, cum tab.; Icones 2 (1581) 108, cum tab.]

[*Pseudosycomorus* Camer., Pl. Epit. Util. Matth. (1586) 181, tab.; Besler, Hort. Eyst. 2 (1613) t. 2.]

[*Azedarach* Dod., Stirp. Hist. Pempt. (1616) 848; Tourn., Inst. Rei Herb. (1700) 616; Burm., Thes. Zeyl. (1737) 40.]

[*Arbor fraxinifolio flore caeruleo* Bauhin, Pinax (1623) 415; Herm., Mus. Zeyl. (1717) 67.]

[*Arbor Azadirachta Syriaca, foliis ramosis, flore caeruleo & albo majore* Breyne, Prod. Rar. Pl. 1 (1680) 3.]

[*Azedarach floribus albis sempervirens* Herm., Hort. Acad. Lugd.-Bat. Cat. (1687) 652, excl. syn. (= *Azadirachta indica*).]
[*Azedarach Indica foliis non deciduis, ossiculo polypyreno* Herm., Parad. Bat. Prodr. (1689) 316.]
[*Azadirachta foliis ramosis minoribus Indica, flore albo subcaeruleo purpurascente majore* Breyne, Prodr. Rar. Pl. 2 (1689) 21; Comm., Hort. Med. Amstel. (1697) 147, t. 76.]
[*Azadirachta foliis ramosis majoribus, Syriaca, sive vulgaris, flore caeruleo majore* Breyne, l.c.]
[*Azedarach sempervirens & florens* Tourn., Inst. Rei Herb. (1700) 616, t. 387.]
[*Azedarach fructu polypyreno* Herm., Mus. Zeyl. (1717) 3; Burm., Thes. Zeyl. (1737) 40.]
[*Melia foliis decompositis* L., Hort. Cliff. (1738) 161; Royen, Fl. Leyd. Prodr. (1740) 462.]
[*Melia foliis duplicato-pinnatis* L., Fl. Zeyl. (1747) 162.]

Tree to 40 m, ± deciduous; bole fluted below when old, to 60(–180, Elmer) cm diam. Bark grey-brown, smooth, lenticellate becoming lightly fissured or scaling with age; inner bark yellowish; sapwood whitish, soft; heartwood rusty brown. Crown of widely spread but sparsely branched limbs. *Twigs* upturned at ends of drooping branchlets, smooth, brown, lenticellate, with raised cicatrices. Leafy twigs c. 6–8 mm diam., ± clothed with fulvous stellate hairs. *Leaves* 15–80 cm, with 3–7 pairs of lateral rachides, each with 3–7 pairs of leaflets, the most proximal of which sometimes replaced with short rachides with a few pairs of leaflets, ± weakly pubescent but usually subglabrous; petiole 8–30 cm, to 6 mm diam., terete, lenticellate, swollen at base; lateral rachides weakly ascendant, to 25 cm long, articulated with articulated main rachis and weakly swollen there. *Leaflets* 3–6(–10) by 1–2.5(–3) cm, ovate or oblong-lanceolate to elliptic, base acute to rounded, apex acuminate, margin entire to variously serrate, costae c. 7–10 on each side, subsquarrose to weakly ascendant and arcuate, looped at margin; petiolules 3–7 mm. *Thyrses* 10–22 cm, axillary or (see note 1 under the genus) on short shoots and in axils of rudimentary leaves thereon, primary branches c. 5–7.5 cm, weakly ascendant, secondary to 2 cm, bearing fascicles of scented flowers; axes ± mealy pubescent; bracts 3–10 mm long, filiform, pubescent caducous, bracteoles similar but smaller; pedicels c. 2–3 mm. *Calyx* c. 2 mm diam.; lobes c. 2 mm long, ovate, stellate- and simple-hairy without, margin ciliate. *Petals* 6–10 by c. 2 mm, narrowly oblong, white to lilac or bluish, stellate- and simple-hairy without, sometimes simple-hairy within, mid-vein conspicuous. *Staminal tube* subglabrous without, ± densely simple hairy within, lobes bifid, or 4-fid, sometimes irregularly so; anthers c. 1.5 mm long, apiculate, ± hairy, inserted opposite lobes. *Disk* obscure and closely enveloping ovary. *Pistil* glabrous; stylehead c. 0.7 mm diam. *Drupe* 2–4 cm long, 1–2 cm diam., plum-shaped, glabrous, yellow-brown when ripe; endocarp very hard. *Seed* c. 3.5 by 1.6 mm, oblong, smooth, brown. — **Fig. 49.**

Distribution — Wild trees are known from India and Nepal, Sri Lanka and tropical China, south and east through *Malesia:* Sumatra, Java, Philippines (Luzon, Negros, Mindanao), Lesser Sunda Islands (Flores, Timor, Wetar), New Guinea, to tropical Australia and the Solomon Islands.

Habitat — Forests, particularly seasonal ones including bamboo thickets (Thailand) and those on limestone, *Tamarindus* woodland and *Eucalyptus* savanna, where it may coppice, to 1200 m altitude (to 1800 m in Himalayan tract). Cultivated forms persist and may become naturalized in secondary vegetation after clearance.

Fig. 49. *Melia azedarach* L., wild form. a. Habit with inflorescence; a_1. leaflet; a_2. leaf; b. half flower; c. top of staminal tube; d. infructescence; e. fruit, cross section; f. seed (a–c, a_1: *de Wilde & de Wilde-Duyfjes 15884*; a_2, d–f: *Metzner 91*). Drawing R. van Crevel.

Taxonomy — The species is a complex of wild and cultivated forms discussed by Mabberley [Gard. Bull. Sing. 37 (1984) 53] of which the following is a condensation.

Forms of this widespread species have been cultivated for over 2500 years and some of them look very different from the statuesque wild trees with pale flowers and mealy

shoots. Plants resembling the wild forms were cultivated at Calcutta in the early 1800s and are grown under 'stove' conditions in Europe; they are rarely planted in the tropics, though they have been long established at Bogor in Java.

By contrast, the widespread Persian Lilac is grown all over the warmer parts of the world and some forms of it can even be grown outside in the British Isles. Such forms are deciduous, almost glabrous and have rather large bluish or lilac, rarely white flowers. The plant was apparently introduced to Malesia by Europeans and, although now widespread, was not mentioned by Rumphius for example. The hardy forms reached Europe via the Persians and Arabs, who knew its medicinal properties but the species seems to have been domesticated long ago in India, where it is still grown for its flowers which are widely used in thank-offerings. The Arabs knew it by the time of Avicenna (sowing methods being discussed in Ibn Bassal's Book of Agriculture [V, sect. 51] of c. 1080) and it was first mentioned in a European text by l'Obel (1576). About this time it seems to have been cultivated in Europe, where, particularly in the Mediterranean, it was soon widely planted and even naturalized. That the dried fruit had a natural channel through it, preadapted the tree for use in rosary-making, such that in Spain it became known as Arbor sancta.

There was at least one more major introduction to Europe, from Sri Lanka, of these Indian cultivars. That form, named by Linné var. *sempervirens*, was being grown in the Netherlands at the end of the 1600s, and was noted for its being more evergreen and more tender than the old Persian Lilac. This seems to have been the form introduced into the West Indies, but it is very close to the original and it is not absolutely clear that it is the West Indian plant. Nevertheless the West Indian plant was taken thence to Africa and reintroduced to Europe as an African plant!

Forms of these Indian cultivars with precocious flowering were selected and named as were ones with white flowers of deeply lobed leaflets some of which seem to have arisen in Java in the nineteenth century. Meantime, the Chinese seem to have been using the tree for patten making in Kwangtung and to have selected certain forms with large fruits and leaflets, with rather entire margins. These, like so many Chinese garden plants, were taken to Japan, where they were known as Tô sendan, that is, Chinese Melia, but, again like many Chinese garden plants, Europeans named them '*japonica*' (twice!). By the 1860s, these Chinese cultivars were well-established in cultivation in Europe and also in tropical botanic gardens, notably Bogor. Because these forms are different from the Indian ones and yet both seem to have been derived from populations of the wild tree, the synonyms relating to the two groups of cultivars are set out below. The very nature of these cultivars denies one hundred percent 'pigeon-holing' of specimens, however.

'Wild' trees

Melia azedarach p.p., i.e. var. *australasica*, var. *cochinchinensis*, var. *glandulosa*, var. *javanica*, var. *squamulosa* — ?*Antelaea javanica* — *Melia dubia* — *Melia composita* — *Melia robusta* — *Melia superba* — *Melia australis* — *Melia candollei* — *Melia australasica* — *Melia azedarach* sensu Blanco — *Melia flaccida* — *Melia tomentosa* sensu Miq. — *Melia birmanica* — *Melia argentea* — *Azedarach sempervirens* var. *australasica* & var. *dubia* — *Melia bogoriensis*.

Tall forest trees to 40 m. *Leaflets* ± entire, dark above, pale below, when young usually densely stellate tomentose like young shoots. *Flowers* sweetly scented, scentless or malodorous (Roxburgh ll.cc.). *Petals* white or pale mauve, often pubescent within. *Staminal tube* creamish or pale mauve darkening to purple with age. *Drupe* up to 4 cm long.

Vernacular names — Marambung (Sumatra); gringging, mindi besar, mindi gedek (Java); mera (Flores); kamè, kamèl (Timor); bagaluga (Visayan, Philippines). For further names see Merrill, Enum. Philipp. Flow. Pl. 2 (1923) 360.

Note — This is the white cedar of commerce and it has been tried in plantations notably in the Philippines. Roxburgh (ll.cc.) reported that trees in the Calcutta Botanic Garden grew to some 12–15 m in 6 years and had boles over a metre in girth.

Chinese cultivars

Melia azedarach p.p., i.e. var. *intermedia*, var. *japonica*, var. *toosendan*, subvar. *intermedia*, subvar. *semperflorens*, subvar. *toosendan*, f. *albiflora* — *Melia japonica* G.Don — *Melia toosendan* — *Melia japonica* Hassk. — *Melia javanica* — *Melia hasskarlii* — *Melia chinensis* – cv. *Toosendan*: Hô, Illus. Fl. S. Viêtnam 2, 1 (1992) 487.

Small trees. *Leaflets* usually almost entire. *Flowers* sweetly scented. *Petals* mauve, pink or blue, rarely white. *Staminal tube* purple.

Distribution — Cultivated. Rarely grown outside botanic gardens in Malesia.

Note — It is the form with fruits larger than those of the Indian cultivars.

Indian cultivars

Melia azedarach s.s., incl. var. *acuminatissima*, var. *floribunda*, var. *glabrior*, var. *incisa*, var. *sambucina*, var. *sempervirens*, var. *subtripinnata*, var. *umbraculifera*, var. *umbraculiformis* f. *umbraculifera* — *Azederach deleteria* — *Melia sempervirens* — *Melia commelini* — *Azederach odorata* — *Melia florida* — *Azedara speciosa* — *Melia arguta* — *Melia sambucina* — *Melia angustifolia* — *Azedaraca amena* — *Melia guineensis* — *Melia bukayun* — *Azedarach commelini* — *Melia cochinchinensis* — *Melia orientalis* — *Melia floribunda* — *Azedarach sempervirens* incl. var. *glabrior* — *Melia sambucina* — *Azedarach vulgaris*.

Small trees. *Leaflets* irregularly serrate, pale green. *Flowers* sweetly scented. *Petals* mauve, pink or blue, rarely white. *Staminal tube* purple.

Distribution — Cultivated throughout the warmer parts of the world, including *Malesia*, where sometimes apparently naturalized. Two named cultivars are striking: 'Floribunda' (*M. floribunda*, *M. azedarach* var. *floribunda*) which flowers when a few dm tall and is widely used in bedding schemes, and 'Umbraculifera' (*M. azedarach* var. *umbraculifera*, f. *umbraculifera*, var. *umbraculiformis*, the Texas Umbrella Tree) which has a flattened crown of branches and arose as a mutant in Texas in the last century. The common form is the Persian Lilac, bead tree, Pride of India, Philippine Lilac, mindi kechil (Mal.), paraiso (Philippines).

Uses — Persian Lilac is one of the most widely cultivated of all tropical trees and is so readily grown as to be despised by the discriminating. Good forms with dark heavily scented flowers are extremely desirable nevertheless. The almost continuous flowering of the species in some areas ensures an unbroken supply of the flowers and of the fruits

which have been long used for beads [see Hoy & Catling, Davidsonia 12 (1981) 65–66 for illustration].

The fruits are toxic to man, some 6–8 considered a fatal dose, and also to pigs but apparently not to birds, sheep or goats; cows fed on the leaves yield tainted milk. The toxic principles are the limonoids, meliatoxins A1, A2, B1, B2 [Oerlichs et al., Phytochemistry 22 (1983) 531].

The wood of different forms of the species has been used for furniture and light construction, notably for ceilings, boats and tea-boxes, while, during the American Civil War, the trees were a commercial source of alcohol (10% by weight from the fruits). In tropical America it has been grown in plantations for the production of fibreboard [Pennington, Flora Neotropica 28 (1981) 24] and is important in the sports goods industries of Pakistan [Amjad & Mohammad, Pak. J. For. 1 (1980) 39].

It has been used as a fast-growing coffee-shade and it has been alleged that fruit trees grown under it remain relatively free from aphids. Indeed a decoction of the fruits has long been used as an insecticide for plants in India and fruits or leaves have been placed with dry fruit, clothing and in books to keep insects away. An ester of 2,3,16,20-tetrahydroxypregnane (a C_{21}-steroid), azedarachol, isolated from root-bark showed antifeedant activity against the insect pest *Ajrotis sejetum* in Japan [Nakatani et al., Phytochemistry 24 (1985) 1945]. In China, the seed-oil has been found to be quite effective as an antifeedant to yellow rice-borers, but not striped nor pink ones, effective against white-backed and brown plant-hoppers but not leaf-hoppers nor rice thrips [Hu et al., J. Agric. Res. China 1983 (1983) 63]. The oil is also effective in control of certain citrus pests, while powdered ripe seeds or lives are mixed with stored grain to preserve it from insect attack [W. & H. Olkowski, IPM Pract. 10, 9 (1988) 1]. Acetone extracts of the fruits are larvicidal but have no effect on the pupae of mosquitoes [Z. Al-Sharook et al., J. Appl. Entom. 111 (1991) 425]. Only trace amounts of the insecticidal salannin (see *Azadirachta* below) have been found in cultivars grown in the USA [Yamasaki et al., J. Chromatogr. 447 (1988) 277]. An extract has also been used as a fish poison.

Although there has been much confusion with neem, *Azadirachta indica* A. Juss., *Melia azedarach* has been widely attributed with medicinal value. The root appears as Cortex Meliae azedarach in pharmacopeiae but it is generally held that the bark is most efficacious, particularly as a vermifuge. For details of its action and other medicinal uses, see Perry, Med. Pl. E & SE Asia (1980) 262. So valued are the fruits in the Malay Peninsula that they have been imported from Szechwan. A glycopeptide called meliacin (not the limonoid with that name), isolated from the leaves and roots is responsible for inhibition of in-vitro replication of various DNA and RNA viruses, e.g. poliovirus, herpes simplex Type I, and prevents development of encephalitis by Tacaribe virus in neonatal mice [Andrei et al., Antiviral Res. 9 (1988) 221]. It also triggers an antiviral state in cells prior to infection, but, although the mechanism is not like that in interferon, it is otherwise not understood.

The seeds also yield an oil and the trunk a gum but these have been little utilized, though the first is suitable for soap and hair oil [Wealth of India 6 (1962) 323 & seqq., q.v. for further uses of the tree].

AZADIRACHTA

Azadirachta A. Juss., Bull. Sc. Nat. Géol. 23 (1830) 236; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 102; Jacobs, Gard. Bull. Sing. 18 (1961) 71; T.D. Penn., Blumea 22 (1975) 464. *Antelaea* auct. non Gaertn.: Adelb., Blumea 6 (1948) 315.

Trees. *Indumentum* of simple hairs. Buds thinly encrusted with resin. *Leaves* pinnate with 2 pairs of glands at base of petiole. *Flowers* bisexual and male on same individual (polygamous). *Calyx* 5-lobed to proximal half, the lobes imbricate. *Petals* 5, free, imbricate. *Staminal tube* cylindrical, slightly expanded at mouth, margin (8–)10-lobed, the lobes rounded, truncate, emarginate or bifid; anthers (8–)10, glabrous, inserted at base of and opposite lobes. *Disk* annular, united with base of ovary. *Ovary* 3-locular, each locule with 2 collateral ovules; stylehead with apical swollen torus with 3 acute, partially united papillose stigmatic lobes. *Fruit* a 1- (or 2-)seeded drupe; endocarp thin, cartilaginous. *Seed* ovoid, distally pointed; testa thin, membraneous with small adaxial sarcotesta; cotyledons plano-convex, collateral; radicle superior, short projecting from cotyledons. Germination phanerocotylar; eophylls opposite, trifoliolate, leaflets deeply incised or pinnatifid. 2n = 28, 30.

Distribution — Two species native to Indomalesia, of which one in *Malesia* proper. The other species, *A. indica*, the neem, is widely cultivated in warm countries throughout the world and is naturalized in some of them.

Habitat — Lowland forest of various types, *A. indica* also colonizing deforested land.

Note — Formerly confused with *Melia*, *Azadirachta* differs in its simple indumentum, pinnate leaves, collateral ovules, 3-lobed stylehead and 1- (or 2-)seeded drupes. Jacobs (l.c.) points out that sterile specimens may be separated in that in *Melia* there is a pair of orbicular glands at the base of the petiole, whereas in *Azadirachta*, there is, in addition, a pair of linear glands below them. Pennington (l.c.) notes that this is most readily seen in living material, where the leaf shape and indumentum are readily observed anyway. The wood is readily distinguished in that that of *Melia* is ring-porous.

KEY TO THE SPECIES

1a. Leaflets with entire margin ..... **1. A. excelsa**
b. Leaflets serrate ..... **2. A. indica**

1. Azadirachta excelsa (Jack) Jacobs

Azadirachta excelsa (Jack) Jacobs, Gard. Bull. Sing. 18 (1961) 75; Wong, Mal. For. Rec. 28 (1976) 81, cum tab.; Mabb. in Tree Fl. Malaya 4 (1989) 233, f. 4. — *Melia excelsa* Jack, Mal. Misc. 11 (1820) 12; Corner, Gard. Bull. Str. Settl. 10 (1939) 263, t. 1, 2; Wayside Trees 1 (1940) 465, t. 155 & 2 (1940) t. 138; ibid., ed. 3 (1988) 504, t. 150; Merr., J. Arnold Arbor. 33 (1952) 235; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 404, cum tab. — *Trichilia excelsa* (Jack) Spreng., Syst. 4, 2 (1827) 252, excl. syn. Blume. — *Azedarach excelsa* (Jack) Kuntze, Rev. Gen. Pl. 1 (1891) 110.

Azadirachta integrifoliola Merr., Philipp. J. Sc., Bot. 4 (1909) 272; Enum. Philipp. Flow. Pl. 2 (1923) 361; Elmer, Leafl. Philipp. Bot. 9 (1937) 3340.

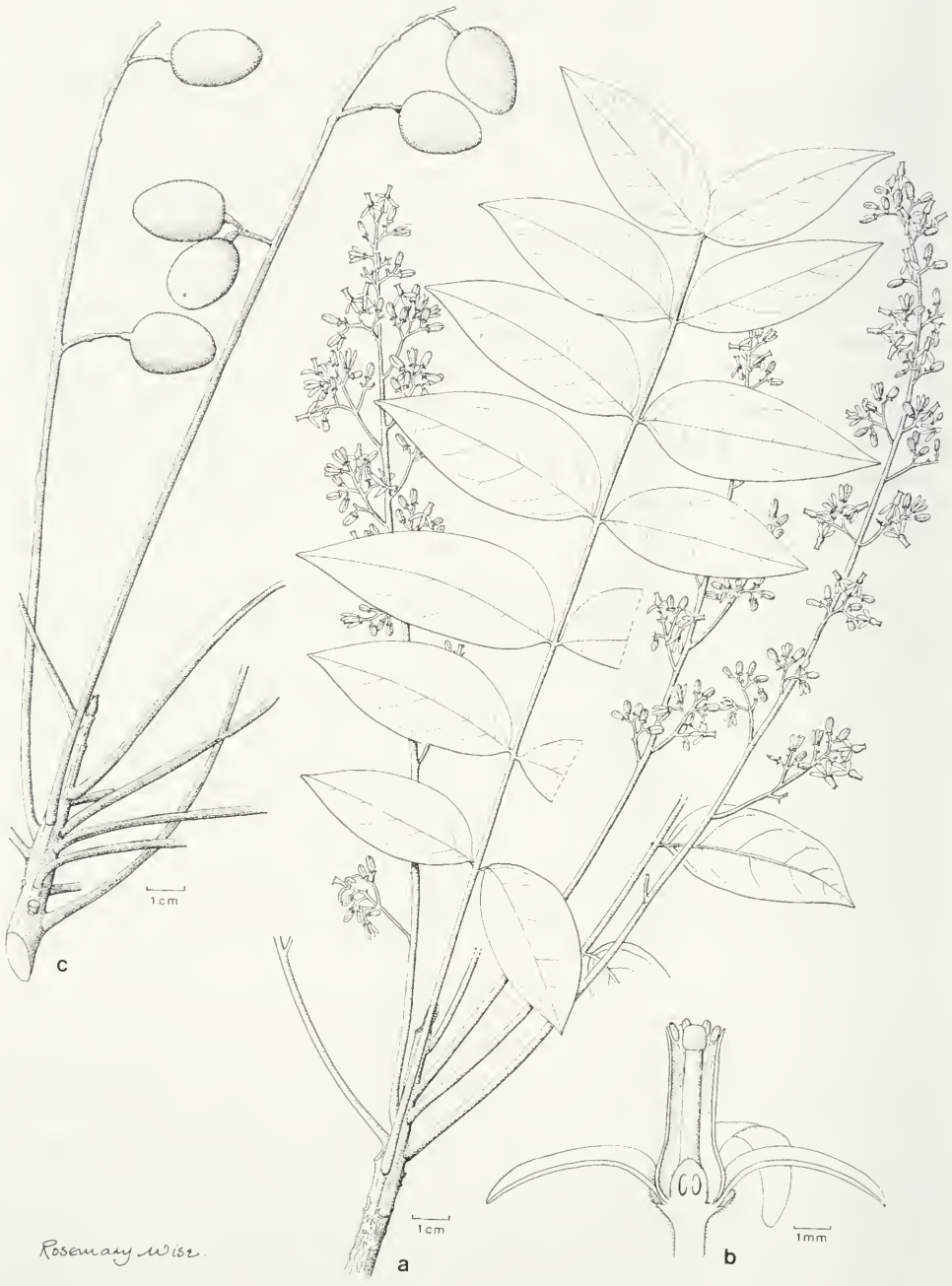

Fig. 50. *Azadirachta excelsa* (Jack) Jacobs. a. Flowering shoot; b. half flower; c. infructescences (a, b: *Cuadra A 1278*; c: *Haniff 301*). Drawing R. Wise. Reproduced with permission from Tree Flora of Malaya 4.

Tree to 50 m; bole to 120 cm diam., regularly cylindric or rarely slightly buttressed over major roots. Bark smooth, pinkish grey or pinkish brown, in large trees becoming longitudinally fissured and scaling, the flakes oblong, greyish, breaking off at upper end and curling up from both ends before shedding, the bole appearing pale brownish or greyish buff and shaggy, sapwood white; heartwood light red. Crown rounded but rather open and uneven, deciduous for up to 3 months a year (Ng), the major branches ascending. Leafy *twigs* c. 8–12 mm diam., the pith pinkish but odourless or weakly onion scented. Young shoots puberulous, soon glabrous. *Leaves* 20–60(–90) cm, 7–11-jugate, pari- (or impari-)pinnate, tufted at ends of twigs; petiole 5–8 cm, ± terete, swollen at base; leaflets 4–12.5 by 2–3.5 cm, the largest near the middle, lanceolate-elliptic, asymmetric, ± falcate, glabrous, pink when young, yellow when withering, bases unequal, apices subacute to subacuminate, margin entire, costae c. 6–11 on each side, arcuate, tertiary venation laxly reticulate; petiolules c. 2 mm. *Thyrses* 20–45 cm, axillary, erect, sweetly scented; axes puberulous, green with 3 or 4 orders of branching, main proximal branches to 8 cm; bracts c. 1 mm long, narrowly triangular, adpressed; pedicels 1–3 mm, articulated with pseudopedicel of same length. *Calyx* c. 1 mm diam., puberulous without; lobes c. 1 mm long, rounded to subacute, pale green, margins ciliolate. *Petals* 5–6.5 by 1.5–2.2 mm, oblong-spathulate, puberulous without, pale creamy white. *Staminal tube* c. 2–2.5 mm diam., glabrous without, sparsely hairy distally within, white or greenish, 10-ribbed, each rib terminating in a subbifid lobe; anthers (8–)10, c. 0.8 mm long, sessile, slightly exserted. *Drupe* 2.4–3.2 by 1.3–1.6 cm, ellipsoid, glabrous, green turning yellow at maturity; pericarp leathery; mesocarp soft, edible, with some white latex. *Seed* smelling of garlic when damaged. — **Fig. 50, 51.**

Distribution — *Malesia:* Sumatra (Bengkulu, East coast), Malay Peninsula (Penang, Perak, Selangor, Malacca, where also a village tree), Borneo (N & E), Philippines [Mindoro, Masbate, Samar, Palawan, Basilan (Elmer, l.c.)], Celebes, Moluccas (Aru Islands), W New Guinea. Hô, Ill. Fl. Vietnam 2, 1 (1992) 488, records this tree from Vietnam.

Habitat — Rain forest to 350 m altitude.

Vernacular names — Kaju bawang, sentang (and variants), surian bawang (Mal.), bawang-bawang (Dugguh), ranggu (Iban, Dusun), turannggoh (Kwijan), danggo, maránggo (Tagb.); New Guinea: asrea (Kebar), bie (Mooi), dabiar (Biak), ibio (Amberbaken, Manikiong), marwa (Mejah), mekedjuf, numbwak (Sidei), nibwak, nubwak (Amberbaken).

Uses — In the Malay Peninsula the timber is used in house-building and the young shoots are eaten as a vegetable (Corner, ll.cc.). It coppices. The seeds yield azadirachtin (see *A. indica*) and the more effective insect antifeedant, marrangin [Ermel et al., J. Appl. Entom. 112 (1991) 512].

Notes — 1. Though a conspicuous tree in the north of the Malay Peninsula and specimens had been known for a long time, the identity of the tree was unknown or confused from the time of Jack until 1936 when Corner studied in Penang the trees which Jack himself may have known.

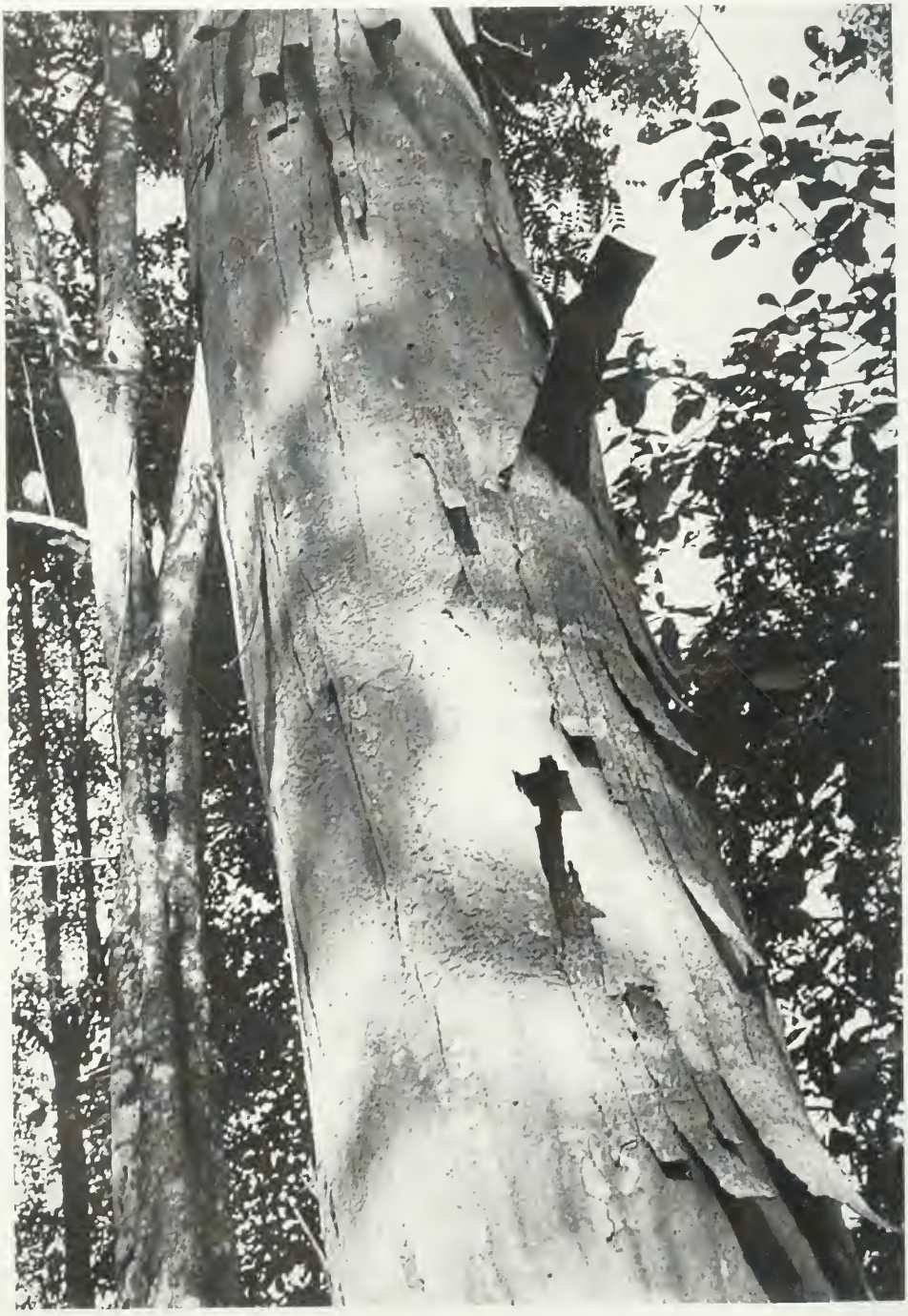

Fig. 51. *Azadirachta excelsa* (Jack) Jacobs. Bole. West Malaysia, Selangor, Kepong. Photograph D.J. Mabberley, 1974.

2. At a distance the tree may be confused with *Ailanthus integrifolia* Lam. (*Simaroubaceae*) but the bark of that tree seems always to be smooth and leaflets wither red and not yellow (Corner, ll.cc.).

2. **Azadirachta indica** A. Juss.

Azadirachta indica A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 221, t. 13, f. 5; Miq., Fl. Ind. Bat. 1, 2 (1859) 533; Suppl. (1861) 502; C.DC. in DC., Monogr. Phan. 1 (1878) 459, t. 6, f. 10; Bisschop Grev., Pl. Ned. Ind. (1883) 491; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 160, f. M–S; ibid., ed. 2, 19b1 (1940) t. 26, f. M–S; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 21; Prinsen Geerl., Teysmannia 13 (1902) 8, cum tab.; Valeton in Hochr., Pl. Bogor. Exsicc. (1904) 66, incl. var. *minor* Valeton & var. *siamensis* Valeton; Cat. Bogor. Nov. (1905) 21, 110, 131, incl. var. *minor* & var. *siamensis*; Backer, Fl. Batavia 1 (1907) 270; Schoolfl. Java (1911) 202; Koord., Exk. Fl. Java 2 (1912) 439; Atlas 1 (1913) t. 164; Briq., Mém. Inst. Nat. Genev. 24 (1935) 44, incl. var. *minor* & var. *siamensis*; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 889; Jacobs, Gard. Bull. Sing. 18 (1961) 74; Backer & Bakh. f., Fl. Java 2 (1965) 120; T.D. Penn., Blumea 22 (1975) 461, t. 4e; [Ruskin], Firew. Crops (1980) 114; Radwanski & Wickens, Econ. Bot. 35 (1981) 398; Ahmed & Grainge, Econ. Bot. 40 (1986) 201; Nicolson et al., Int. Hort. Malab. (1988) 190; Tewari, Monogr. Neem (1992). — *Melia azadirachta* L., Sp. Pl. (1753) 385; DC., Prodr. 1 (1824) 622; Blume, Bijdr. (1825) 161; Griff., Notul. 4 (1854) 500; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 5; Hiern in Hook. f., Fl. Brit. India 1 (1875) 544; Ridley, Fl. Malay Penins. 1 (1922) 384; Vaughan, Struct. Util. Oil Seeds (1970) 155, t. 82 E–F; Corner, Seeds Dicots 1 (1976) 191. — *Antelaea azadirachta* (L.) Adelb., Blumea 6 (1948) 315. — [*Melia fraxinifolia* Salisb., Prodr. (1796) 317, nom. superfl. — *Azedarach fraxinifolia* Moench, Meth. Suppl. (1802) 58, nom. superfl.] — [*Melia pinnata* Stokes, Bot. Mat. Med. 2 (1812) 482, nom. superfl.] — [*Melia indica* (A. Juss.) Brandis, For. Fl. NW & C India (1874) 67, nom. superfl.; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1443; Corner, Wayside Trees 1 (1940) 466, 2 (1940) t. 139; ibid., ed. 3 (1988) 504, t. 151; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 405, cum tab.]

[*Arbor indica, fraxino similis, oleae fructu* Bauhin, Pinax (1623) 416.]

[*Arbor Azadirachta Indica foliis non ramosis, flore minore* Breyne, Prodr. Rar. Pl. 1 (1680) 3.]

[*Aria Bepou* Rheede, Hort. Mal. 4 (1683) 107, t. 52.]

[*Olea malabarica Nimbo dicta, fructu racemoso oblongo* Ray, Hist. Pl. 2 (1688) 1545.]

[*Azadirachta Indica foliis Fraxini, sive non ramosis majoribus, flore minore albo* Breyne, Prodr. Rar. Pl. 2 (1689) 21.]

[*Olea malabarica, Fraxineo folio* Pluk., Almag. (1696) 269, t. 247, f. 1.]

[*Azedarach altera foliis semilunatis* Herm., Mus. Zeyl. (1717) 48.]

[*Azedarach foliis falcato-serratis* Burm., Thes. Zeyl. (1737) 40, t. 15.]

[*Melia foliis pinnatis* L., Hort. Cliff. (1738) 161; Fl. Zeyl. (1747) 161; Royen, Fl. Leyd. Prodr. (1740) 462.]

Tree to 16 m; bole to 60 cm diam. Bark red-brown or greyish, fissured and flaking in old trees; inner bark red-brown with colourless, sticky foetid sap; sapwood whitish. Leafy *twigs* c. 4–8 mm, cicatrose, with pale vertical lenticels, garlic-scented when damaged. *Leaves* 15–35 cm, imparipinnate or paripinnate with terminal spike, 4–7-jugate, red when young, garlic-scented when damaged; petiole c. 3–7 cm, c. 1.5 mm diam., subglabrous, base weakly swollen. *Leaflets* opposite to subopposite, 5–9 by 1.5–3.5 cm, the subapical the largest, falcate-lanceolate, curved basipetally, subglabrous, bases very asymmetric, acute, apices long-acuminate, margin serrate, costae c. 15 on each side, obtuse, spreading; petiolules c. 1–2 mm. *Thyrses* to 30 cm, lax, paniculiform, axillary or in axils of fallen leaves, sweetly scented; axis c. 1.5 mm diam., subglabrous;

branches to c. 15 cm, squarrose, bearing branchlets to 2 or 3 more orders, tipped with cymules of 1–3 flowers, finely sericeous; bracts and bracteoles c. 0.5–1 mm, lanceolate, ± pubescent; pedicels c. 2 mm, swollen at articulation with pseudopedicel, c. 2.5–4 mm, finely pubescent. *Calyx* c. 1 mm long, salveriform, the lobes rounded, pubescent, margins ciliate. *Petals* linear spathulate, 4–6 mm long, white, ± pubescent on both surfaces. *Staminal tube* glabrous to sparsely pubescent, 10-ribbed, margin with 10 rounded or somewhat laciniate lobes; anthers 10, c. 0.8 mm long, narrowly ellipsoid, basifixed, weakly exserted. *Ovary* glabrous to finely pubescent. *Drupe* c. 1–2 cm long, ellipsoid, green becoming yellow when ripe; mesocarp thin, fleshy.

Distribution — Probably native in Burma but widely and long cultivated in tropical Asia and Africa, where it has become extensively naturalized. In *Malesia* planted in Sumatra, the Malay Peninsula, and West Java, also in East Java, and the Lesser Sunda Islands (Bali, Lombok, Sumbawa), where it is, like *Tamarindus indica* L. (*Leguminosae*), so completely naturalized in the greatly modified seasonal forest areas there as to appear native.

Habitat & Ecology — Where naturalized, in open thickets and savanna, to 225 m altitude. In West Africa, where the tree has come to dominate large areas of the savanna, the seeds are dispersed by fruit bats and baboons, after passage through which their germination is enhanced [Lieberman et al., Ecology 60 (1979) 65–75].

Vernacular names — Neem or nim tree, mimba, mimbo, nimbo (from Sanskrit), margosa tree (from Portuguese for bitter).

Uses — See also the paragraph on Phytochemistry, p. 8. Held sacred by the Hindus, the neem is potentially one of the most important of all tropical seasonal forest trees, having proved to be very adaptable and able to withstand arid conditions. It can be grown in impoverished soil and is a fastgrowing source of fuelwood [Ruskin, l.c.; see also M. Jacobson (ed.), Focus on phytochemical pesticides, vol. 1 (1988); Ad hoc panel of Nat. Res. Counc., Neem – a tree for solving global problems (1992); Tewari, l.c.].

The form grown in West Africa is ignored by stock and is therefore readily established. Some forms in Asia, however, are used as fodder and in the Malay Peninsula the young leaves and flowers are boiled and eaten with rice (Corner, l.c.). In Central America, it is now widely planted and recent trials have shown it to grow rapidly and produce fine timber which makes a good substitute for *Swietenia* mahogany [Pennington, Fl. Neotropica 28 (1981) 25]. It is the most important plantation species in northern Nigeria and is used as poles or for fuel. It coppices well and the timber has a very high calorific value. Coppice shoots may reach 10 m height in two years. The wood is tougher than teak and resists decay. It is also widely planted as a windbreak, shade and avenue tree, the world's biggest plantation being of 50,000 trees in the plains of Saudi Arabia, planted to shade the two million or so Muslim pilgrims camping there annually for 'Haj' rites [Sallem Ahmed et al., Econ. Bot. 43 (1989) 35]. It is a soil ameliorant and is potentially a source of many valuable by-products (Radwanski & Wickens, l.c.). It has been an ingredient of soaps, toothpaste and lotions in commerce for some decades (Corner, l.c.).

The seeds contain some 40% oil by weight and this bitter material has been used in lamps and as a lubricant and has potential as a fuel-source, the mesocarp being a promising substrate for the production of methane gas.

Neem cake is an excellent fertilizer and the leaves and twigs are used as a mulch in Asia.

The bark produces a valuable gum and tannin worth exploiting. The pressed leaves have long been put in books to ward off insects, the repellent being the limonoid, azadirachtin, which is in the seeds as well as the leaves; house-sparrows in India incorporate leaves into their nests, perhaps reducing parasite loads. Azadirachtin is absorbed by plants and acts as a systemic insecticide so efficient that Japanese beetles and other insects, even including the desert locust, will starve rather than eat plants treated with it. It has been alleged that the substance is repellent to nematodes as well (Ruskin, l.c.). Of the many limonoids known from the tree, deacetylaxadirachnol (salannin) is as potent as azadirachtin in inhibiting ecdysis in tobacco budworm [Kubo et al., Tetrahedron 42 (1986) 489]. Neem seed powder with carbofuran greatly reduces leaf-hoppers and rice tungro virus in rice [Kareem et al., Int. Rice Res. Newsl. 13 (1988) 35]. Reduction in the incidence of phloem-specific tungro viruses in neem-treated plants is attributed to a shift in insect-feeding from phloem to xylem vessels [Saxena et al., J. Econ. Entom. 80 (1987) 1079].

Neem is alleged to contain anti-culicid factors and may be effective in controlling the spread of malaria. Under the Sanskrit name nimba it is mentioned in the Ayurvedae (Systema Medicinae) of Susruta, one of the most ancient of the Hindu medical writings. The first European account was published by Garcia d'Orta, physician to the Portuguese Viceroy at Goa in India, in 1563. The leaves, bark and seed oil have medicinal properties summarized by Perry, Med. Pl. E & SE Asia (1980) 260, and have been used in the treatment of a wide range of ailments, including malaria, eczema, dysentery and ulcers, but is particularly effective as a parasiticide for skin diseases such as scabies. Nimbidin, a substance isolated from the seed oil, has been found to be an efficient anti-inflammatory agent in artificially induced arthritis and oedema in rats [Pillai & Santhakumari, Pl. Medica 43 (1981) 59], while an aqueous extract of the bark has been shown to increase lymphocyte function such that production of MIF, a lymphokine, is increased, which may account for the generally stimulating and skin-healing properties long observed [Van der Nat et al., J. Ethnopharmacol. 19 (1987) 125]. Some of the triterpenoids have antibacterial activity [Siddiqui et al., J. Nat. Prod. 55 (1992) 303]. Neem oil also has significant post-coital contraceptive action [Sinha et al., Ind. J. Med. Res. 79 (1984) 131].

Notes — 1. Gametogenesis and embryogenesis are discussed by Garudamma, J. Ind. Bot. Soc. 35 (1956) 222 & 36 (1957) 227.

2. Neem can be an aggressively invasive tree and it needs careful control to prevent its swamping other crops (Ruskin, l.c.).

Tribus Sandoriceae

Sandoriceae T.D. Penn., Blumea 22 (1975) 507.

Trees. *Indumentum* of simple hairs. *Leaves* trifoliolate. *Flowers* in axillary thyrses. *Staminal tube* cylindrical, ribbed distally; anthers 10, included. *Disk* tubular. *Stylehead* with 4- or 5-lobed stigma. *Fruit* a drupe. *Seeds* exarillate, pachychalazal; endosperm absent; cotyledons thick, plano-convex, collateral.

The following genus only.

SANDORICUM

Sandoricum Cav., Diss. 7 (1789) 359; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 170; T.D. Penn., Blumea 22 (1975) 507; in Fl. Neotrop. 28 (1981) 359; Mabb., Blumea 31 (1985) 146.

Calyx ± truncate to shallowly 4- or 5-lobed. *Petals* (4) 5, free, imbricate. *Staminal tube* margin with 5 or 10 short lobes; anthers glabrous. *Disk* free, margin coarsely toothed. *Ovary* slightly sunken in receptacle, 4- or 5-locular, locules each with 2 collateral ovules. *Drupe* 1–5-locular, pyrenes 1- (or 2-)seeded; outer mesocarp rather dry-fleshy or soft and fibrous, inner mesocarp fleshy or spongy-fibrous; endocarp thin, cartilaginous. *Seeds* kidney-shaped, laterally compressed with thin sarcotesta; radicle apical, extending to surface or slightly exserted. Germination phanerocotylar; eophylls trifoliolate, opposite.

Distribution — Five species, all but one (*S. koetjape*) restricted to western *Malesia*, where the cultivated forms of *S. koetjape* may have arisen, though wild relations appear to be native as far east as New Guinea. All five are wild in Borneo, to which three species are restricted.

Habitat — Dipterocarp, kerengas and other forest types. *Sandoricum beccarianum* is restricted to peat swamp forests, *S. borneense* to riparian ones.

Uses — The fruit (where known as mature) of all species is edible and the timber of some value.

KEY TO THE SPECIES

1a. Leaflets obovate (to elliptic), apex rounded or emarginate. Peat swamp forests ... **5. S. beccarianum**
b. Leaflets lanceolate, ovate (or elliptic), apex ± acuminate. Other habitats 2
2a. Leaflets glabrous, lanceolate (or elliptic), base obtuse to rounded. — Borneo, river banks ..... **3. S. borneense**
b. Leaflets pubescent to subglabrous (or glabrous), ovate, base cuneate to rounded 3
3a. Leaflets long acuminate (acumen to 24 mm), base cuneate. — Borneo ..... **4. S. caudatum**
b. Leaflets acute to acuminate (acumen never more than 15 mm), base rounded, obtuse to acute (or subcuneate)..... 4

4a. Calyx 4–4.5 mm long, dark brown; petals glabrous; staminal tube with 5 erose lobes; petiolule of apical leaflet 4–10 cm. — Borneo ..... **1. S. dasyneuron**

b. Calyx c. 3.5 mm, yellow-green; petals ± pubescent; staminal tube with 10 bifid lobes; petiolule of apical leaflet 3–5.5 cm ..... **2. S. koetjape**

1. Sandoricum dasyneuron Baill.

Sandoricum dasyneuron Baill., Adansonia 11 (1874) 265; C.DC. in DC., Monogr. Phan. 1 (1878) 462; Becc., For. Born. (1902) 602; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319; Mabb., Blumea 31 (1985) 147.

Tree 8–10(–25) m, bole 10–25 cm diam. Bark smooth; wood light red. Leafy *twigs* c. 6–8 mm diam. *Indumentum* ferrugineous. *Leaves* 25–52 cm long; petiole 10–20.5 cm, ± pilose, base ± swollen. *Leaflets* broadly ovate, glabrous adaxially, ± pilose abaxially especially on veins, bases acute to subcuneate, apices acuminate, acumen to 15 mm, costae (10–)12 or 13 on each side, inarched only near margin, apical leaflet 17–24 by 12–16 cm, laterals 16–20 by 10–11 cm, petiolules 3–15 mm on lateral leaflets, 4–10 cm on apical. *Thyrses* 2–13 cm long, weakly sweetly scented, produced with new leaves over at least 6 nodes, sparsely branched often from very close to base, primary branches to 6 cm long, squarrose, bearing fascicles of 1–3 flowers; axes densely short-tomentose; bracts c. 7 mm long, narrowly triangular, densely pubescent, caducous; bracteoles c. 1–2 mm, narrowly triangular, densely pubescent, caducous; pedicels c. 5–7 mm, articulated with pseudopedicel, 1(–2) mm long, continuous with calyx. *Calyx* c. 4 mm long, 4–5 mm diam., campanulate, glabrous, dark purplish brown, splitting into 5 irregular obtuse lobes to 1 mm deep, margin ciliate. *Petals* 5, 8–9 by c. 3 mm, spathulate, glabrous, greenish-white, apices acute. *Staminal tube* fleshy, white, swollen at mouth, ± pubescent without, pilose within, margin with 5 erose lobes; anthers 10, 1.5 mm, in two ranks, the more distal opposite lobes, the more proximal inserted between them, all weakly exserted. *Disk* c. 2 mm long, narrowing towards mouth, membraneous, glabrous, margin irregularly laciniate. *Ovary* and style glabrous; stigmatic lobes c. 1.5 mm long. *Drupe* globose-pyriform, densely and minutely fulvous tomentellous, when mature (non vidi) 10 cm diam., multi-ribbed longitudinally (Beccari, l.c.); pyrenes at least 3, bean-shaped. *Seeds* (non vidi) 2.5 cm long (C.DC., l.c.).

Distribution — *Malesia:* Borneo (Sarawak, Brunei, Kalimantan), rarely collected.

Habitat — Hill-sides and ridges in mixed dipterocarp forest and ecotone to kerengas (Sarawak), *Agathis* forest on acid sands (W Kutai), 50–600 m altitude.

Vernacular names — Atap bojig (Land Dayak), kelampu (Iban, Malay), krunpok (Iban).

Uses — According to Beccari, the drupe has much edible sweet flesh but it leaves a garlicky taste in the mouth.

2. Sandoricum koetjape (Burm.f.) Merr.

Sandoricum koetjape (Burm.f.) Merr., Philipp. J. Sc., Bot. 7 (1912) 237; Fl. Manila (1912) 274; Barrett, Philipp. Agr. Rev. 6 (1913) 498, t. 3a; Pratt et al., Philipp. J. Sc. Chem. Geol. 8 (1913) 80, t. 12, f. 1; Webster, Philipp. Agr. Rev. 8 (1915) 110, t. 8b; Merr., Interpr. Rumph. (1917)

308; Sp. Blanc. (1918) 209; Webster, Philipp. Agr. Rev. 13 (1920) 184, t. 17b; Popenoe, Man. Trop. Fr. (1920) 426; Brown, Bull. Philipp. Dept. Agr. Bur. For. 21 (1920) 86, t. 41; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319; Philipp. J. Sc. 19 (1921) 329; Enum. Philipp. Flow. Pl. 2 (1923) 361; Mend., Man. Pl. Breed. Trop. (1926) 296; Ochse, Ind. Vrucht. (1927) 125, t. 61; Fr. Cult. Dutch E Ind. (1931) 65, t. 26; Juliano, Philipp. Agr. 23 (1934) 11, 253; Villegas, Univ. Philipp. Nat. Appl. Sc. Bull. 5 (1936) 293; Jimenez, Philipp. Agric. 26 (1937) 587; Corner, Wayside Trees 1 (1940) 466 & 2 (1940) t. 140, 141; Adelb., Blumea 6 (1948) 316; Steenis, Fl. Scholen Indon. (1949) 233; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 891; Quisumb., Med. Pl. Philipp. (1951) 486; Intengan et al., Philipp. J. Sc. 84 (1955) 361; King & Morgan, J. Chem. Soc. (1960) 4738; Yiagan, Philipp. Agric. 44 (1961) 477; Ramirez, Philipp. Agric. 45 (1961) 275; Backer & Bakh. f., Fl. Java 2 (1965) 121; Molesw. Allen, Mal. Fr. (1967) 105, t. 38; Meijer, Bot. News Bull. Sabah 8 (1967) 81; Anon., Wealth India 9 (1972) 200; Whitman, Proc. Fla St. Hort. Soc. 87 (1974) 379, t. 3, 4; Corner, Seeds Dicots 1 (1976) 191 & 2 (1976) t. 375b; L.M. Perry, Med. Pl. E & SE Asia (1980) 262; Chin & Yong, Malays. Fr. Col. (1981) 29 cum tab.; T.D. Penn. in Fl. Neotrop. 28 (1981) 359; Mabb., Blumea 31 (1985) 147; Corner, Wayside Trees, ed. 3 (1988) 504, t. 152, 153; Phillips et al., Guide Market Fr. SE Asia (1985) 66; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 342, t. 261; Mabb. in Tree Fl. Malaya 4 (1989) 249, f. 8B; de Vogel, Seedlings Dicots (1990) 355, f. 129; Hô, Ill. Fl. Vietnam 2, 1 (1992) 489. — *Melia koetjape* Burm. f., Fl. Ind. (1768) 101. — [*Trichilia nervosa* Vahl, Symb. 1 (1790) 31, nom. superfl.; Willd., Sp. Pl. 2 (1799) 554; DC., Prodr. 1 (1824) 623; Spreng., Syst. 3 (1826) 68; G. Don, Gen. Syst. 1 (1831) 682. — *Sandoricum nervosum* (Vahl) M. Roem., Synops. Monogr. 1 (1846) 108, non Blume.]

Sandoricum indicum Cav., Diss. (1789) 359, t. 202, 203; Lam., Encycl. Méth. 3 (1789) 69; Ill. (1793) t. 350; Willd., Sp. Pl. 2 (1799) 556; Sm. in Rees, Cyclop. 31, 1 (1815) Sandoricum n. 1; Roxb., Pl. Coast Corom. 3 (1820) 58, t. 261; DC., Prodr. 1 (1824) 621; Blume, Bijdr. (1825) 164; G. Don, Gen. Syst. 1 (1831) 680; Roxb., Fl. Ind., ed. Carey, 2 (1832) 392; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 232, t. 16, f. 15; Wight & Arn., Prodr. (1834) 120; J. Graham, Cat. Pl. Bombay (1839) 31; Blanco, Fl. Filip., ed. 2 (1845) 242; M. Roem., Synops. Monogr. 1 (1846) 108; D. Dietr., Syn. 4 (1847) 789; Paxt., Mag. Bot. 15 (1849) 111, 116 cum tab.; Hassk., Retzia 1 (1855) 146; Hort. Bog. Descr. 1 (1858) 125; Miq., Fl. Ind. Bat. 1, 2 (1859) 541; Suppl. (1861) 196; Drury, Handb. Ind. Fl. 1 (1864) 165; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 32; Bedd., Fl. Sylv. (1872) iv, (1873) t. 319; Hiern in Hook. f., Fl. Brit. India 1 (1875) 553, incl. var. *velutinum* Hiern; Kurz, For. Fl. Burma 1 (1877) 217; C.DC. in DC., Monogr. Phan. 1 (1878) 461, t. 6, f. 11; Blanco, Fl. Filip., ed. 3 (1878) 85, t. 127; Fern.-Vill., Nov. App. (1880) 42; Bisschop Grev., Pl. Ned. Ind. (1883) 494; Laness., Pl. Util. Colon. Fran. (1886) 310; Vidal, Rev. Vasc. Pl. Fil. (1886) 82; Watt, Dict. Econ. Prod. Ind. 6, 2 (1893) 457; King, J. As. Soc. Beng. 64, ii (1895) 23; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 161, f. A–E; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 27; Pierre, Fl. For. Cochinch. 5 (1897) t. 353A, incl. var. *cochinchinense* Pierre; Koord., Minah. (1898) 389; Ridley, Agr. Bull. Malay Penins. 8 (1898) 228; Agr. Bull. Str. Fed. Malay St. 1 (1902) 429; Becc., For. Born. (1902) 574; Gamble, Man. Ind. Timb., ed. 2 (1902) 149; Perkins, Fragm. Fl. Philipp. (1904) 31; Brandis, Indian Trees (1906) 137; Merr., Philipp. J. Sc. 1, Suppl. (1906) 71; Backer, Fl. Batavia (1907) 274; Guillaumin, Rev. Gén. Bot. 22 (1910) 468, t. 12, f. 3; Backer, Schoolfl. Java (1911) 210; Pellegr. in Fl. Indo-Chine 1 (1911) 732, cum tab., incl. var. *cochinchinense*; Whitford, For. Philipp. 2 (1911) 46, t. 34; Koord., Exk. Fl. Java 2 (1912) 440; Atlas 1 (1913) t. 182; Crev. & Lem., Cat. Prod. Indoch. 1 (1917) 227; Basu, Ind. Med. Pl. (1918) 313, t. 221; Troup, Silv. Ind. Trees (1921) 204; Ridley, Fl. Malay Penins. 1 (1922) 385; C.E. Parkinson, For. Fl. Andam. (1923) 117; Craib, Enum. Pl. Siam. 1 (1926) 353; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1946; Briq., Mém. Inst. Nat. Genev. 24 (1935) 45; Rodger, Handb. For. Prod. Burma (1936) 64; Elmer, Leafl. Philipp. Bot. 9 (1937) 3386; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 35, f. A–E; Pellegr. in Fl. Indo-Chine, Suppl. (1946) 687; Tix., J. Agr. Trop. Bot. Appl. 5 (1950) 596; Chittenden, Dict. Gard. 4 (1951) 1863; Nair, Phyton 10 (1958) 145; Worth., Ceyl. Trees (1959) t. 129; Hô & Duong, Fl. Vietnam (1960) 248, t. 90B.

[*Azedarach edulis* Noronha, Verh. Batav. Gen. 5, ed. 1 (1791) art. 4, 5, nomen.]

Sandoricum nervosum Blume, Bijdr. (1825) 163; Hassk., Retzia 1 (1855) 146; Hort. Bot. Descr. (1858) 125; Miq., Fl. Ind. Bat. 1, 2 (1859) 541; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 32; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 30; Backer, Schoolfl. Java (1911) 210; Koord., Exk. Fl. Java 2 (1912) 440; Koord., Atlas (1913) t. 183; Ridley, Fl. Malay Penins. 1 (1922) 385; Craib, Enum. Pl. Siam. 1 (1926) 254; Burkill & Haniff, Gard. Bull. Str. Settl. 6 (1930) 183; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1948.

Trichilia venosa Spreng., Syst. 3 (1826) 68; G. Don, Gen. Syst. 1 (1831) 682. — *Sandoricum venosum* (Spreng.) M. Roem., Synops. Monogr. 1 (1846) 109.

?*Sandoricum serratum* G. Don, Gen. Syst. 1 (1831) 680; M. Roem., Synops. Monogr. 1 (1846) 109; D. Dietr., Syn. 4 (1847) 789.

Sandoricum ternatum Blanco, Fl. Filip. (1837) 346; M. Roem., Synops. Monogr. 1 (1846) 109.

Sandoricum glaberrimum Hassk., Retzia 1 (1855) 145; Hort. Bogor. Descr. (1858) 124; Miq., Fl. Ind. Bat. 1, 2 (1859) 541.

Sandoricum maingayi Hiern in Hook. f., Fl. Brit. India 1 (1875) 554; C. DC. in DC., Monogr. Phan. 1 (1878) 462, incl. var. *quadripetalum* C. DC.; King, J. As. Soc. Beng. 64, ii (1895) 22; Becc., For. Born. (1902) 201, 599; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319, incl. var. *quadripetalum*; Ridley, Fl. Malay Penins. 1 (1922) 385; Meijer, Bot. News Bull. Sabah 8 (1967) 81.

Sandoricum borneense auct. non Miq.: Fern.-Vill., Nov. App. (1880) 43; Vidal, Cat. Pl. Prov. Man. (1880) 22.

[*Sandoricum harmandianum* Pierre ex Laness., Pl. Util. Colon. Fran. (1886) 310, nomen.]

Sandoricum radiatum King, J. As. Soc. Beng. 64, ii (1895) 21; Ridley, Agr. Bull. Str. Fed. Malay St. 1 (1902) 429.

Sandoricum harmandii Pierre, Fl. For. Cochinch. 5 (1897) t. 353B, excl. fol. (= *Aglaia* sp.); Pellegr. in Fl. Indo-Chine 1 (1911) 733.

Sandoricum vidalii Merr., Philipp. Govt. Lab. Bur. Bull. 6 (1904) 8; Whitford, For. Philipp. 2 (1911) 46, t. 35; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 361; Elmer, Leafl. Philipp. Bot. 9 (1937) 3387.

Sandoricum harmsianum Perkins, Fragm. Fl. Philipp. (1904) 31.

Sandoricum ledermannii Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 172, 177, nomen; Bot. Jahrb. 72 (1942) 204.

[*Hantol* Kamel, App. Herb. Luz. Philipp. (1704) 54.]

[*Sandoricum domesticum* Rumph., Herb. Amb. 1 (1741) 167, t. 64.]

Tree to 45(–50) m; bole to 1 m diam., fluted and sometimes with buttresses to 3 m tall. Bark pale pinkish brown, smooth, lenticellate to peeling with round flakes; inner bark pink; sapwood pale yellow; heartwood pink or reddish. *Twigs* cicatrose, lenticellate, rough, grey-brown. Crown domed. Leafy twigs 4–7 mm diam., subglabrous to fulvous-tomentose. *Leaves* 18–40 cm long; petiole 7.5–16 cm, flattened (or even winged in sicco) adaxially towards the ± swollen base, subglabrous to fulvous pubescent. *Leaflets* ovate, glabrous or with a few brown hairs on midrib adaxially, subglabrous to densely brown pubescent abaxially, pink when young, withering yellow or reddish, bases acute to rounded, ± asymmetric on lateral leaflets, apices acuminate, costae 7–14 (–20 in cultivated forms) on each side, looped near margin, apical leaflet 8–20 by 5–14 cm, laterals usually smaller and narrower; petiolules 4–9 mm on lateral leaflets, 3–5.5 cm on apical. *Thyrses* 2.5–24 cm long, fragrant, produced in up to 8 of the most apical axils, erect or weakly drooping; axes ± fulvous pubescent; primary branches to 8 cm long, squarrose, bearing secondary branches of glomerules of 1–5 flowers; bracts c. 7 mm long, narrowly triangular, densely pubescent, caducous, bracteoles somewhat smaller, subopposite; pedicels c. 3–5 mm, articulated with pseudopedicels, c. 1–1.5 cm long, continuous with calyx. *Calyx* c. 3.5 mm long, campanulate to cupular, splitting

Fig. 52. *Sandoricum koetjape* (Burm. f.) Merr. a. Leaf and inflorescences; b. half flower; c. fruit; d. seedling. — *S. beccarianum* Baill. e. leaf and inflorescence; f. half flower; g. fruit. Drawing R. Wise. Reproduced with permission from Tree Flora of Malaya 4.

into 5 irregular obtuse or rounded lobes to 0.75 mm deep, pubescent, margin ciliate, yellow-green. *Petals* (4 or) 5, 6–9 mm long, linear-lanceolate to oblanceolate, yellowish-green or pinkish, ± pubescent without, reflexed at anthesis, apices rounded to emarginate. *Staminal tube* ± pubescent without, pilose within, pale yellow to orangeish, margin with 10 lobes acute to bifid, somewhat reflexed at anthesis; anthers (8 or) 10, 1–1.5 mm long, narrowly oblong, apiculate, ± in 2 ranks, weakly exserted. *Disk* c. 1.5 mm long, membraneous, glabrous, margin irregularly laciniate. *Ovary* and style glabrous; stigmatic lobes c. 1.5 mm long. *Drupe* 5–8 cm diam., flattened-globose, velvety, yellow or brownish when ripe, smooth to longitudinally wrinkled; pericarp with milky latex; mesocarp white, translucent, juicy sweet to very sour; endocarp tough, with 1 or 2 seeds. *Seeds* 20–35 by 12–21 mm, 9–16 mm thick, germinating in rotting fruit; cotyledons pink inside. — **Fig. 52a–d.**

Distribution — Planted widely in the Asiatic tropics but probably native only in *Malesia*, the wild form (see below) extending from the Malay Peninsula and Sumatra throughout the archipelago to New Guinea (Madang). The pubescent cultivated form with leaves withering red (Parkinson, l.c.) is that planted in India including the Andamans, Burma, Indochina, the Mascarenes and the New World as well as grown under glass in Europe.

Habitat & Ecology — Native and naturalized in primary and secondary forests to 1200 m altitude or more. Wild trees are very scattered in the forest, Whitmore [Trop. Rain For. Far East (1975) 237] recording them at a density of 0.8 trees per 40 ha in Ulu Kelantan, Malay Peninsula. In Singapore the leaves are dropped biannually, leaving the crown almost bare, but the new leaves appear within a week (Corner, l.c. 1940). The fruits mature in 2–3 months and may lie carpeting the ground under the tree thereafter. The flowering in the Malay Peninsula is so regular that formerly it was recognized as the cue for rice-planting (Burkill, l.c.).

Morphology — Juliano (ll.cc.) has shown that the sequence of development of the floral parts is: sepals, petals, androecium, carpels and lastly disk. He also gives details of micro- and macrosporogenesis. Villegas (l.c.) reports that the mesocarp is derived from the inner pericarp walls and as outgrowths from the endocarp, and that the indumentum of the drupe develops after fertilization, the ovary being glabrous. Similar is reported by Pennington [Flora Neotropica 28 (1981) 11] for two neotropical species of *Trichilia*.

Cytology — The form known as 'Native' has 2n = 22, whereas the robust cultivated 'Bangkok' (= 'Manila') has 2n = 44 and is a tetraploid (Ramirez, l.c.) and 2n = 16, 28, 32 have also been recorded by Pennington [Blumea 22 (1975) 508]. There is no evidence for apomixis and records of polyembryony probably rest on a confusion of the 1- or 2-seeded 'stones' with seeds (Juliano, ll.cc.). Juliano also recorded a case of one tree in Manila which never produced fruit. This was due to the failure of the corolla to open and no self-pollination took place even though mega- and microsporogenesis were normal.

Systematics — This species embraces the cultivated fruit trees known as sentul (and variants) and kechapi (and variants), grown throughout western Malesia, largely as village trees, for shade as well as fruit. The form known as kechapi in the narrow sense,

i.e. that with robust pubescent twigs, a brown pubescent adaxial surface to the large leaves, and with many costae in the leaflets is that most frequently encountered in the Philippines and probably the only form cultivated outside Malesia, being early carried to Indochina, the Mascarenes and now increasingly in the New World, notably Costa Rica (Pennington, l.c.) and especially Florida (Whitman, l.c.), where a robust form of it is known as 'Manila' which may serve as a cultivar name. The robust form introduced to the Philippines in 1949 from Thailand was called 'Bangkok', compared with the original 'Native' (Ramirez, l.c.). This latter is probably the Red Sentol of Corner (1940) who notes that the tree has leaves which wither red, pale green petals and a sweet or sour fruit with a thick generally wrinkled or uneven pericarp and often rotting on the tree. It seems to be the form originally described by N. Burman and Cavanilles, though there is considerable variation in the cultivated trees in terms of pubescence and the form and taste of the fruit. A specimen from J. Burman's herbarium and now preserved at L has much less pubescent leaflets, for example. Wild trees in the Malay Peninsula and eastwards to New Guinea, beyond the range of cultivation of the Red Sentol, have more delicate twigs, smaller subglabrous leaves, withering yellow, the leaflets with fewer costae and pinkish petals in rather shorter inflorescences, the fruits sweet-tasting with thinner smoother pericarp and falling when ripe. In the Philippines and from Celebes eastwards, the two forms seem perfectly distinct but in western Malesia it becomes impossible to draw a clear line between them. Indeed, it is tempting to speculate that it is here, where all the other species in the genus are also native, different forms have been selected from the variable wild populations. It is interesting to compare the origin of 'Manila' with the robust form of the *Lansium domesticum* aggregate known as 'Kokossan' (q.v.).

Vernacular names — Throughout the archipelago and beyond, different forms are known variously as sentul (or variants) and kechapi (or variants) though apparently, as in the case of *Lansium domesticum*, not consistently, even within islands (see Corner 1940). It is notable that the scientific name is compounded of both names, *Sandoricum* being Rumpf's latinization of the first and koetjape being Burman's hollandicization of the second. Variants are listed by K. Heyne (l.c.) and Merrill (1923). The wild form in the Philippines is known as malasantol or bago-santol or variants (Merrill, l.c.).

Uses — The mesocarp is the part eaten. In some forms it is exceedingly sweet and the sour ones may be 'excruciating' (Corner 1940). Nevertheless, some trees have excellent flavour and Popenoe (l.c., quoting Webster) remarks that should seedless or semi-seedless forms be found, the sentul could "become one of the most popular of the tropical fruits." An excellent jam has been prepared from the fruits (Barrett, l.c.) which in some forms smell like ripe peaches. Rumpf notes that the fruit may be eaten raw or cooked, like lemons, with fish in Ambon. It may also be candied or fermented with rice in the production of an alcoholic drink. Although not particularly high in Vitamin C, it is a good source of Vitamin B [Hermano & Sepulveda, Philipp. J. Soc. 54 (1934) 70]. See also Sotto in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 284.

The tree is fast growing when young, Roxburgh (l.c.) recording that a 24-year-old tree in the Calcutta Botanic Garden had a bole with a circumference of over 2 m. The

tree has been widely planted for shade: it is recommended as an avenue species. The timber is red, moderately hard and takes a fine polish. Rumpf records that it was a durable timber for house construction in Ambon but Anon. (1972) reported that it perishes on exposure to water and borers. Nevertheless, it is in much demand in Burma for the manufacture of sandals and has been used in the construction of barrels, boats, carts and butchers' blocks. The bark has been used in tanning fishing nets. It, and also particularly the roots, are claimed as efficacious in the treatment of a number of medical conditions (see Perry for digest), its value being known in the seventeenth century and recorded by Mercado [see Fern.-Vill., Nov. App. (1880) 42]. Stems yield the triterpenoids 3-oxo-olean-12-en-29 oic acid, its 3-dihydroderivative katonic acid and an A-ring seco derivative of katonic acid called koetjapic acid, $C_{30}H_{46}O_4$; the first-named two components have significant cancerostatic activities in cell cultures [Kaneda et al., J. Nat. Prod. 55 (1992) 654]. Two new limonoids, sandoricin and 6-hydroxysandoricin, have been isolated from the seeds; both have been tested for insect-antifeedant activity with larvae of two lepidopteran species and found to be active [Powell et al., J. Nat. Prod. 54 (1991) 241].

3. **Sandoricum borneense** Miq.

Sandoricum borneense Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 33; C.DC. in DC., Monogr. Phan. 1 (1878) 463; Valeton, Ic. Bogor. 1 (1897) t. 10; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319; Schwartz, Mitt. Inst. Allg. Bot. Hamb. 7 (1931) 235; Meijer, Bot. News Bull. Sabah 8 (1967) 81; T.D. Penn., Blumea 22 (1975) 506, t. 14e; Ashton in UNESCO, Trop. For. Ecosyst. (1978) 92; Mabb., Blumea 31 (1985) 150.

Tree 7–20 m; bole to 15 m, 20–40(–60) cm diam., unbuttressed. Bark smooth, pale brown, with small lenticels; inner bark light brown or pinkish; sapwood white. Leafy *twigs* 3–4(–5) mm diam., smooth, often pale in sicco. *Indumentum* restricted to innovations. *Leaves* 22–38 cm long, red when young; petiole 4–10 cm, terete to somewhat flattened adaxially near base. *Leaflets* elliptic to lanceolate-ovate, bases obtuse to rounded, those of laterals often markedly asymmetric, apices acuminate, costae about 9–12 on each side, arising almost at right angles from midrib, very weakly arcuate and looped at margin; apical leaflet not conspicuously larger than laterals, 8–22 by 3.5–8.5 cm; petiolules 3–5(–10) mm on lateral leaflets, 20–45 mm on apical. *Thyrses* 10–16 cm long, ± erect, narrow, fragrant; primary branches to 6 cm long, subsquarrose to weakly ascending, the secondaries c. 1.5 cm long, bearing cymules of 1–5 flowers; bracts narrowly triangular, c. 8 mm long, to foliaceous, when lanceolate to oblanceolate, 2 cm long and petiolate, caducous; bracteoles narrowly triangular, c. 4 mm long, caducous; pedicels 3–7 mm long, glabrous to subpuberulous. *Calyx* 1.5–2 mm long, shallowly cupular, ± puberulous, pale green, splitting irregularly into 5 obtuse lobes c. 0.5 mm deep. *Petals* 5, 6–8 mm long, linear-oblong, glabrous, creamy green to pinkish, apices acute. *Staminal tube* creamy green to pinkish, glabrous and with c. 20 ribs without, villous within, margin 10-lobed, each lobe ± bifid; anthers c. 0.5 mm long, in two ranks, alternating with the lobes, apiculate, weakly exserted. *Disk* c. 2 mm long, glabrous, margin 5-lobed, the lobes ± bifid. *Ovary* and style glabrous; stigmatic lobes c. 1 mm

long. *Drupe* 2.5–4 cm diam., subglobose to pyriform, velutinous, buff-yellow to orangeish, obscurely longitudinally ribbed, usually solitary; pericarp with milky latex; mesocarp sweet but mealy; endocarp tough; pyrenes 2–5. *Seeds* c. 14 by 9 mm (Valeton, l.c.); cotyledons pink within.

Distribution — *Malesia:* Borneo (Sarawak, southern Sabah, northern Kalimantan).

Habitat & Ecology — Riverbanks, subject to inundation down to just above tidal influence. According to Ashton (l.c. and in litt. 29 xii 1982), it is a common riverside tree in Brunei, overhanging the water like *Dipterocarpus oblongifolius* (neram). The fruits are dropped into the water and devoured by fish which appear to spit out the pyrenes. Whether such leads to dispersal is unknown (cf. *Dysoxylum angustifolium*).

Vernacular names — Apoh (Kaya), apok (Kenyah), kelampu (Iban).

Uses — The sparsely produced fruits are edible and the timber is good for 'sapé'-making.

4. **Sandoricum caudatum** Mabb.

Sandoricum caudatum Mabb., Blumea 31 (1985) 150, f. 1.

Small tree to 10 m and bole to 15 cm diam. Bark smooth, grey-green. Leafy *twigs* c. 3–4 mm diam. *Indumentum* fulvous, restricted to innovations. *Leaves* 20–25 cm long; petiole 5–9 cm, wrinkled in sicco, base swollen and flattened adaxially. *Leaflets* ovate, bases cuneate, ± asymmetric on lateral leaflets, apices long acuminate, acumen to 24 mm, costae 8–10 on each side, arcuate, looped well clear of margin; apical leaflet 14–15.5 by 6–7 cm, laterals 10–13 by 4–6 cm; petiolules wrinkled in sicco, 6–9 mm on lateral leaflets, 4–5 cm on apical. *Thyrses* 4–7 cm long, sparsely branched; borne in axils of undeveloped leaves, primary branches to 2 cm long, squarrose, bearing fascicles of 2 or 3 flowers; axes minutely puberulous; bracts subtending primary branches 5–7 mm long, narrowly lanceolate, puberulous, caducous; bracteoles at base of pedicels smaller, often with 1 or 2 more, smaller ones half way to articulation with pseudopedicel; pedicels c. 5–6 mm; pseudopedicels c. 1–2 mm continuous with calyx. *Calyx* c. 2.5 mm long, shallowly campanulate, ± puberulous, pale green, splitting into 5 irregular obtuse lobes c. 0.75 mm deep, margin ciliate. *Petals* 5, c. 4.5 mm long (immature), c. 2 mm wide, elliptic, apex rounded, creamy white. *Staminal tube* glabrous without, villous within, margin with 10 irregular lobes, creamy white; anthers 10, ± in two ranks, alternating with lobes, c. 0.75 mm long, oblong, weakly exserted. *Disk* c. 1.5 mm long, glabrous, membraneous, clasping ovary, margin laciniate. *Ovary* and style glabrous; stigmatic lobes c. 1 mm long. *Drupe* solitary, at least 5 cm long, 3.5 cm diam., stipitate, rostrate, stipe to 1 cm, beak to 6 mm, densely yellow-brown, velutinous, ± ribbed longitudinally, calyx marcescent, pyrenes 3 or 4. *Seeds* c. 16 mm long, 9 mm wide (immature); cotyledons reddish in sicco.

Distribution — *Malesia:* Borneo (Sarawak, 1st Div.: 8 collections only).

Habitat — Lowland dipterocarp forest and kerangas to 350 m altitude.

Note — Neither mature flowers nor mature fruits are known.

5. Sandoricum beccarianum Baill.

Sandoricum beccarianum Baill., Adansonia 11 (1874) 264; Mabb., Blumea 31 (1985) 151; in Tree Fl. Malaya 4 (1989) 249.

Sandoricum emarginatum Hiern in Hook. f., Fl. Brit. India 1 (1875) 264; C.DC. in DC., Monogr. Phan. 1 (1878) 461; King, J. As. Soc. Beng. 64, ii (1895) 22; Becc., For. Born. (1902) 574; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 319; Ridley, Fl. Malay Penins. 1 (1922) 385; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1946; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 890; Anderson, Gard. Bull. Sing. 20 (1963) 165; Meijer, Bot. News Bull. Sabah 8 (1967) 81; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 77, 86, 89.

Tree to 35 m with bole to 25 m and 70 cm diam. Bark smooth with minute cracks to deeply fissured; inner bark red-brown, to 10 mm thick; sapwood whitish to pale brown; heartwood pink to red-brown. Leafy *twigs* c. 3–5 mm diam. *Indumentum* restricted to innovations. *Leaves* 11–25 cm long; petiole 3–7 cm, weakly swollen and flattened adaxially at base. *Leaflets* obovate (to elliptic), bases acute to subcuneate; apices emarginate or rounded (to obtuse), sometimes mucronate, costae 6–8 on each side, weakly arcuate and rather obscurely looped near margin; apical leaflet 5.5–14 by 3.5–9 cm, laterals 4–12 by 2.5–7 cm; petiolules 3.5–10 mm on lateral leaflets, 4–6 cm on apical, all somewhat swollen at junctions with laminae and grooved adaxially in sicco. *Thyrses* 1–5.5 cm long, produced with new leaves and from axils of fallen ones up to at least ten nodes from apex, fasciculate, apparently arising in the axils of undeveloped leaves in axillary buds; primary branches to 2 cm long, bearing fascicles of 1–4 flowers; axes minutely puberulous to glabrous; bracts c. 1 mm long, narrowly triangular, pubescent, caducous; bracteoles 1–3, c. 0.5 mm long, narrowly triangular, pubescent, borne half way up pedicel to articulation with pseudopedicel; pedicels c. 4–6 mm long, conspicuously articulated with pseudopedicel, c. 1 mm long, continuous with calyx. *Calyx* c. 2–2.5 mm long, shallowly cupular, ± puberulous, red-brown, margin truncate to irregularly (4- or) 5-lobed, the lobes up to 1 mm deep, obtuse, margin ± ciliate. *Petals* (4) 5, 6–7 by 2.5 mm, oblanceolate, yellow-green to white, glabrous. *Staminal tube* fleshy, deeply (16- or) 20-ribbed, cream, ± pilose within, margin with (8) 10 emarginate lobes; anthers (8) 10, 1 mm long, ovate, apiculate, in one rank, inserted opposite lobes, very weakly exserted. *Disk* c. 2 mm long, membraneous, glabrous, margin irregularly laciniate. *Ovary* and style glabrous; stigmatic lobes c. 1 mm long. *Drupe* (immature) c. 3 cm long, 2.5 cm diam., subglobose, stipitate, stipe to 5 mm, densely minutely tomentellous, orange-red or pinkish-yellow, pericarp with white latex. *Seeds* 2, c. 2 cm long, 1 cm diam. — **Fig. 52e–f.**

Distribution — Thailand and *Malesia:* coastal regions of Sumatra, Malay Peninsula, Borneo.

Habitat — Peatswamp forests; it may be codominant locally (Brünig), to 30 m altitude.

Vernacular names — Apau, kelampu apau (Sarawak), gapas-gapas, kapas-kapas (Sabah), kechapi or sentul kera or kerok (i.e. baboon's sentul) (Sumatra).

Uses — The fruit is edible and also eaten by Siamang (Chivers). The timber is yellowish-red and durable, being used as planks in ship- and house-building in Sumatra. Burkill (l.c.) reports that it reached the Singapore sawyers.

Subfamily SWIETENIOIDEAE

Swietenioideae Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 267, 270; T.D. Penn. & Styles, Blumea 22 (1975) 511.

Monoecious trees. Buds nearly always protected by scale leaves. *Leaves* pinnate, spirally arranged. Locules nearly always with 3 or more *ovules*, these biseriate; stylehead discoid or very rarely capitate. *Fruit* a septifragal capsule with a central columella and seeds winged, or capsule subwoody or leathery with rudimentary columella and seeds unwinged but with a woody or corky outer layer.

Tribus Swietenieae

Swietenieae A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 236 (tribus *Cedrelacearum*); T.D. Penn. & Styles, Blumea 22 (1975) 513.

Flowers with or without a gynophore. *Petals* free. *Stamens* 8–10 (11), filaments partly or completely united into a cylindrical, urceolate or bowl-shaped tube, margin lobed or not. *Capsule* woody, nearly always with a well-developed columella, the valves sometimes splitting into an outer woody and an inner membraneous layer. *Seeds* variously winged; cotyledons collateral, flattened; (residual) endosperm present.

Distribution — Pantropical. Nine genera, five restricted to Africa and Madagascar, one to India and Sri Lanka, two to tropical America and the following.

CHUKRASIA

Chukrasia A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 239; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 65; T.D. Penn. & Styles, Blumea 22 (1975) 519. — [*Chickrassia* Wight & Arn., Prodr. (1834) 122, nom. superfl.] — [*Plagiotaxis* Wall., List (1829) n. 1269, 1270, nom. nud., ex Kuntze, Rev. Gen. Pl. 1 (1891) 110, nom. superfl.]

Deciduous trees. *Indumentum* of simple hairs. *Leaves* paripinnate with terminal spike, imparipinnate and bipinnate with incised or lobed leaflets in juveniles, rarely retained at maturity. *Thyrses* axillary, often subterminal appearing terminal. *Calyx* 4- or 5-lobed. *Petals* 4 or 5, free, contorted and much longer than calyx in bud. *Staminal tube* cylindrical, somewhat narrowing distally, margin entire to crenulate; anthers attached to margin. *Disk* obscure to narrowly cushion-shaped. *Ovary* flask-shaped, 3–5-locular, each locule with numerous ovules; stylehead capitate with 3–5 stigmatic ridges. *Capsule* ovoid or ellipsoid, woody, opening by 3–5 valves from the apex, the valves splitting into an outer and inner bifid layer; columella with 3–5 sharply angled ridges, extending to apex of capsule; seed scars conspicuous. *Seeds* 60–100 per locule, wings terminal, arranged laterally in tiers in two ranks; endosperm present; cotyledons subcircular; radicle obliquely exserted. Germination phanerocotylar; cotyledons unequal-sided; eophylls opposite, irregularly imparipinnate, the leaflets lobed or irregularly toothed. 2n = 26.

Distribution — One somewhat variable species from India and Sri Lanka, eastwards through tropical Asia to western Malesia.

Chukrasia tabularis A. Juss

Chukrasia tabularis A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 241; Linnaea 6 lit. (1831) 115; Mém. Mus. Nat. Hist. Nat. 19 (1832) 251, t. 22, f. 27; C.DC. in DC., Monogr. Phan. 1 (1878) 726, t. 8, f. 9, incl. var. *malaccana* C.DC.; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 271, t. 152, f. S, T; Pierre, Fl. For. Cochinch. 5 (1897) t. 357C, incl. var. *attopeuensis* Pierre; Cooke, Fl. Bomb. (1902) 216; Brandis, Indian Trees (1906) 144; Pellegr. in Fl. Indo-Chine 1 (1911) 780, t. 84, f. 5–11, incl. var. *attopeuensis*, var. *dongnaiensis* (Pierre) Pellegr., var. *microcarpa* (Pierre) Pellegr., var. *velutina* (M. Roem.) Pellegr.; Gamble, Fl. Madras 1 (1915) 186; C.E. Parkinson, For. Fl. Andam. (1923) 119, t. 2, f. 37; Livera, Ann. Roy. Bot. Gard. Perad. 9 (1925) 308; Merr. & Chun, Sunyatsenia 1 (1930) 61, incl. var. *velutina*; Alston in Trim., Handb. Fl. Ceylon 6 (1931) 46; Merr. & Chun, Sunyatsenia 2 (1934) 32; Briq., Mém. Inst. Nat. Genev. 24 (1935) 34, t. 1, f. 9; Harms, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 50, t. 4, f. S, T; Pellegr. in Fl. Indo-Chine, Suppl. (1946) 721, incl. var. *quadrivalvis* Pellegr.; Anon., Wealth of India 2 (1950) 152, t. 66; How & Chen, Acta Phytotax. Sin. 4 (1955) 32, incl. var. *velutina*; Worth., Ceylon Trees (1959) t. 124; Anon., Icon. Corm. Sin. 2 (1972) 571, t. 2872, incl. var. *velutina*; Bull. Dept. Med. Pl. Nepal 4 (1973) 12; Fl. Hainan 3 (1974) 70, t. 572; T.D. Penn. & Styles, Blumea 22 (1975) 522, t. 18c, d; Wu, Fl. Yunnan. 1 (1977) 211, t. 49, f. 1–4, incl. var. *velutina*; Whitmore, Enum. Flow. Pl. Nepal 2 (1979) 85; Mabb. in Tree Fl. Malaya 4 (1989) 256, f. 10. — *Chickrassia tabularis* (A. Juss.) Wight & Arn., Prodr. (1834) 123; J. Graham, Cat. Pl. Bombay (1839) 32 ('*tubularis*'); Wight, Ill. 1 (1840) t. 56 ('*tubularis*'); M. Roem., Synops. Monogr. 1 (1846) 135; Thwaites, Enum. (1858) 61; Drury, Handb. 1 (1864) 171; Bedd., Fl. Sylv. (1869) 9, t. 9; Kurz, Rep. Veg. Andam. (1870) 33; Hiern in Hook. f., Fl. Brit. India 1 (1875) 568; Kurz, For. Fl. Burma 1 (1877) 227; Theob. in Mason, Burma, ed. 3, 2 (1883) 586, incl. var. *genuina* Theob., nom. superfl. & var. *velutina* (M. Roem.) Theob.; Laness., Pl. Util. Colon. Fr. (1886) 312; Watt, Dict. Econ. Prod. India 2 (1889) 268; Trimen, Handb. Fl. Ceylon 1 (1893) 252; Talbot, Trees Bomb., ed. 1 (1894) 43; ed. 2 (1902) 117; King, J. As. Soc. Beng. 64, ii (1895) 88, incl. var. *velutina* (M. Roem.) Theob.; Gamble, Man. Ind. Timb., ed. 2 (1902) 156; Prain, Beng. Pl. (1903) 223; Talbot, For. Fl. Bomb. 1 (1909) 248, t. 147; Basu, Ind. Med. Pl. (1918) 320, t. 229; Troup, Sylv. Ind. Trees (1921) 191, t. 79; Ridley, Fl. Malay Penins. 1 (1922) 415; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 524; Kanjilal et al., Fl. Assam 1 (1936) 241; Chittenden, Dict. Gard. 1 (1951) 459.

Swietenia trilocularis [Roxb. ex Buch.-Ham., Journey Madras 1 (1807) 184, nom. nud., ex] G. Don, Gen. Syst. 1 (1831) 688. — *Chickrassia trilocularis* (G. Don) M. Roem., Synops. Monogr. 1 (1846) 135.

Swietenia chickrassa Roxb., Hort. Beng. (1814) 33, nom. nud.; Fl. Ind., ed. Carey, 2 (1832) 399. — *Chukrasia chickrassa* (Roxb.) Schultze-Motel, Kulturpfl., Beih. 4 (1966) 209. — [*Plagiotaxis chickrassa* Wall., Cat. (1829) n. 1269, nom. nud.; Kuntze, Rev. Gen. Pl. 1 (1891) 110, nom. superfl.]

[*Plagiotaxis velutina* Wall., Cat. (1829) n. 1270, nom. nud.; Kuntze, Rev. Gen. Pl. 1 (1891) 110, nom. superfl.] — *Chickrassia velutina* M. Roem., Synops. Monogr. 1 (1846) 135; Kurz, For. Fl. Burma 1 (1877) 227. — *Chukrasia velutina* (M. Roem.) C.DC. in DC., Monogr. Phan. 1 (1878) 727, incl. var. *macrocarpa* C.DC.; Pierre, Fl. For. Cochinch. 5 (1897) t. 357, incl. var. *dongnaiensis* Pierre & var. *microcarpa* Pierre; Cooke, Fl. Bomb. (1902) 216; Brandis, Indian Trees (1906) 145; Livera, Ann. Roy. Bot. Gard. Perad. 9 (1925) 308; Alston in Trim., Handb. Fl. Ceylon 6 (1931) 46; Briq., Mém. Inst. Nat. Genev. 24 (1935) 34; Worth., Ceylon Trees (1959) t. 125. — [*Swietenia velutina* Wall. ex Kurz, J. As. Soc. Beng. 42, ii (1873) 65, nom. in syn.]

[*Swietenia sotrophola* Buch.-Ham. ex Wall., Cat. (1829) n. 1269, nom. in syn.]

Cedrela sp.: Wall., Cat. (1831/32) n. 4892.

Chickrassia nimmonii R. Graham ex Wight, Ill. 1 (1840) 148; Dalz. & Gibs., Bomb. Fl. (1861) 38; Drury, Handb. 1 (1864) 171. — *Chukrasia nimmonii* (R. Graham ex Wight) Merr. & Chun, Sunyatsenia 1 (1930) 61, nom. provis.

Sapindus multijugus Wall., Cat. (1847) n. 8099.

Melia tomentosa auct. non Roxb.: Kurz, Rep. Andam. (1867) iv.

[*Swietenia villosa* Wall. ex Kurz, J. As. Soc. Beng. 42, ii (1873) 65, nom. in syn.]

Dysoxylum esquirolii Lévl., Cat. Pl. Yunnan (1916) 176; China Rev. Ann. (1916) 23.

Fig. 53. *Chukrasia tabularis* A. Juss. a. Leaf and inflorescence; b. seedling; c. young leaf; d. half flower; e. fruit, closed and dehisced; f. seed. Drawing R. Wise. Reproduced with permission from Tree Flora of Malaya 4.

Tree to 40 m; bole to 25 m, fluted below, to 120 cm diam. Buttresses convex, to 150 cm tall. Bark dark brown, fissured vertically and scaling or cracking into rectangular blocks; inner bark red brown or pinkish; sapwood straw, heartwood yellow to reddish-brown. *Twigs* grey, bark cracking horizontally. Leafy twigs 4–6 mm diam., lenticellate. *Leaves* 30–50 cm, with 6–12 leaflets on each side, ± short-pubescent; petiole 4–9 cm, ± terete, swollen at base. *Leaflets* ovate to oblong, ± asymmetric or even falcate, the subapical the largest, 10–17.5 by 3.5–6.5 cm, the most proximal as small as 4 by 2.2 cm, bases obtuse to rounded distally, acute to cuneate proximally, apices acute to acuminate, subglabrous to finely scattered short pubescent adaxially, subglabrous except for short hairs on veins and domatia in axils of costae to densely velutinous abaxially, chartaceous to subcoriaceous, costae c. 9–11 on each side of largest leaflets, arcuate, ± bifurcating near margin; petiolules 2–6 mm. *Thyrses* 10–30 cm long, primary branches to 16 cm, squarrose to ascending, secondary to 4 cm, bearing fascicles of sweetly-scented (*Muscari*, Mabberley) flowers; axes short-pubescent; bracts 2–7(–10) mm, narrowly triangular, often caducous, bracteoles similar but smaller; pedicels c. 3–4 mm, articulated with pseudopedicels c. 2 mm long, continuous with calyx. *Calyx* c. 2.5–3.5 mm diam., shallowly cupular, ± pubescent without lobes obtuse, c. 1/3 length of calyx. *Petals* c. 12–16 mm long, narrowly oblong to subspathulate, creamy green or yellowish, often tinged pink, subglabrous or puberulent (especially on sectors exposed before anthesis). *Staminal tube* glabrous, colour as petals, anthers c. 1 mm long, oblong. *Ovary* densely adpressed pubescent. *Infructescence* pendulous with up to 6 fruits. *Capsule* (2.5–)3.5–5 cm long, 2.5–4 cm diam., dark brown, lenticellate. *Seeds* c. 1.2 cm long. — **Fig. 53.**

Distribution — India and Nepal, east- and southeastwards from southern China and Hainan, Sri Lanka and the Andamans to western *Malesia:* Sumatra (north but rare), Malay Peninsula (but not in the south), Borneo (limestones of 1st Div., Sarawak).

Habitat — Rain forest and semi-deciduous forest, including bamboo forests and those on limestone, to 900 m altitude. It is a colonist of bare ground, including road cuttings in the Malay Peninsula.

Vernacular names — Suntang (Mal.); ranggu (Sarawak).

Uses — The timber is an export of Burma and India, where boles to 6 m girth have been recorded, and is known in world commerce as chickrassy, yinma or Chittagong wood. On seasoning, it tones down to a golden mahogany shade with a beautiful satiny sheen and is often figured handsomely. In China it is favoured for carving as well as construction work. The tree may be coppiced and it has been tried in tropical Australian plantations, but it is susceptible to the depredations of *Hypsipela* moths.

The tree yields a gum which is marketed mixed with others in India, while the flowers are the source of a dye. An extract from the twigs has proved an efficacious antifeedant against *Pieris rapae* in southern China [W. & H. Olkowski, IPM Pract. 10, 9 (1988) 3]. The seeds contain some 50% oil but how this is utilized is unrecorded. The bark is astringent. In Europe, the plant has been cultivated as a greenhouse ornamental.

Note — The trees from Sarawak and the Malay Peninsula are almost glabrous, whilst in Sumatra both this form and a densely pubescent one have been collected. The

latter is paralleled by '*Chukrasia velutina*' in India and Sri Lanka, where Livera [Ann. Roy. Bot. Gard. Perad. 9 (1925) 308] has argued that it is possible to distinguish two species on the basis of pubescence, the number of anthers and of leaflets, the shape of the latter and so forth. Examination of more copious materials break down these distinctions and there are, in any case, a number of specimens intermediate in pubescence between these extremes. Both the most pubescent and the subglabrous are recorded from India, Burma, Thailand and southern China as well, again with intermediates. Those concerned with provenances for forestry may find it useful to use an informal classification for such forms, the pubescent of which may prove to be ecotypes of more seasonal forests (N.B.: If these forms were to be recognized at the species level, they would have to be known as *C. nimmonii*, not *C. velutina*). Moreover, bracts from populations in the west of the range appear, on the whole, to be longer, while, in Indochina, there are forms with smaller-than-average fruits and one with juvenile foliage apparently retained at maturity [var. *dongnaiensis* (Pierre) Pellegr.].

Tribus Cedreleae

Cedreleae (R.Br.) DC., Prodr. 1 (1824) 624; T.D.Penn. & Styles, Blumea 22 (1975) 511. — *Cedrelaceae* R.Br. in Flinders, Voy. Terra Austr. 2, App. (1814) 64.

Trees. *Flowers* with an androgynophore, petals adnate to it. *Stamens* 5, free, sometimes with a whorl of staminodes. *Capsule* woody or membraneous, with a soft columella. *Seeds* winged at one or both ends; cotyledons flat, leaf-like; residual endosperm present.

Distribution — Two genera, *Cedrela* L. in tropical America and the following.

TOONA

(J. M. Edmonds)

Toona (Endl.) M. Roem., Synops. Monogr. 1 (1846) 131, 139; Pellegrin in Fl. Indo-Chine 1 (1911) 792; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 269; ed. 2, 19b1 (1940) 44, t. 2.; T.D.Penn. & Styles, Blumea 22 (1975) 512; Bahadur, Monogr. Toona (1988) 1–251. — *Cedrela* L. sect. *Toona* Endl., Gen. Pl. 2 (1840) 1055. — [*Surenus* Rumph., Herb. Amb. 3 (1743) 66, t. 39, ex Kuntze, Rev. Gen. Pl. 1 (1891) 110, nom. superfl. pro *Toona*; T.Post & Kuntze, Lex. Gen. Phan. (1903) 543.]

[*Cuveraca* Jones, Asiat. Res. 4 (1790) 281, nom. inval.]

[*Mioptrila* Raf., Am. Man. Mulb. Trees (1839) 37, nom. provis.]

Cedrela L., p.p.: Ridley, Fl. Malay Penins. 1 (1922) 415; Burkill, Gard. Bull. Str. Settl. 5 (1930) 120; Dict. Econ. Pl. Malay Penins. (1935) 499; Symington, Malay For. 4 (1935) 119.

Deciduous or semi-evergreen trees up to 50 m tall, monoecious. Bark fissured, sometimes flaking irregularly, grey-brown; inner bark pink to red; sapwood cream. *Leaves* paripinnate, occasionally imparipinnate. *Leaflets* entire, serrate or dentate; glabrous or pubescent with simple hairs; club-shaped glands often associated with the vascular system; domatia (small deltate axillary pockets) usually present on proximal lateral veins of lower surfaces, often bordered with simple hairs. *Inflorescences* much-branched pen-

dent thyrses, often exceeding a metre in length. *Flowers* 5-merous, unisexual with well-developed vestiges of the opposite sex present, rarely hermaphrodite, small. *Calyx* 5-(rarely 6-)lobed or of 5 (rarely 6) free sepals, which are imbricate or cupulate in bud; sepal margins always ciliate. *Petals* 5 (rarely 6), free, longer than the calyx in bud, imbricate (quincuncial), basally adnate to a short pulvinate (cushion-shaped) androgynophore (disk); white, cream or pink. *Stamens* 5 (rarely 6), free, arising from the androgynophore, sometimes alternating with 1–5 filamentous staminodes; anthers in male flowers yellow, dehiscing laterally; antherodes in female flowers often sagittate, brown with abortive pollen. *Ovary* 5-locular, each locule with 6–10 ovules, vestigial in male flowers; styles short in female flowers, pistillodes long and slender in male flowers; stylehead discoid with stigmatic papillae, usually 5-rayed. *Fruit* a pendulous thinly woody, ellipsoidal or obovoidal, septifragal capsule; valves 5, brown, smooth to verrucose, opening from the apex. Columella softly woody, concavely or convexly 5-angled, extending to the capsule apex. *Seeds* winged either at both ends when attached towards the distal end of the columella, or at one end when attached by the seed-end to the proximal part of the columella; wings membraneous, seeds with residual endosperm. Cotyledons collateral, flattened, leaf-like; radicle laterally exserted. Germination phanerocotylar; first true leaves opposite, trifoliolate with deeply lobed or dentate leaflets.

Distribution — An Old World genus of 4 or possibly 5 species, extending from eastern Pakistan through SE Asia and southern China to eastern Australia. Three species occur in *Malesia*.

Habitat — Primary and secondary rain forest, low- to mid-montane, up to 2900 m altitude.

Uses — The timbers of *Toona* spp. are highly prized but generally scarce. *Toona ciliata* was the most important native timber in Australia but is now largely cut out; the Malesian species seem to be undergoing a similar fate. Extracts from the bark, heartwood and leaves apparently have insecticidal qualities.

Systematics — The genus is closely allied to the neotropical *Cedrela* with which it has been repeatedly united and separated from since 1840. Pennington & Styles (1975) proposed clear arguments for the recognition of two distinct genera, with *Cedrela* being differentiated from *Toona* by a columnar androgynophore longer than the ovary, and seedlings having entire leaflets. The genera are also distinguishable by various other characters, with chromosomal evidence suggesting different evolutionary histories. Species of the genus *Toona* are extremely variable, especially in their vegetative morphology; average parameters have not been included in all of the species descriptions.

Monographic study of this genus has demonstrated that it is composed of very few species, and that phenotypic plasticity and genetic variation are responsible for much of the taxonomic complexity reflected in the literature. The species exhibit a phenomenal range of morphological variation, both within and between trees of the same population, and many of the features used by earlier workers to define their taxa, have proved to be only slight morphological variants. Such vegetative characters include leaf and leaflet

size; leaflet and leaflet-margin shape; indumentum type and hair density. In particular, the velutinous pubescence, on which a number of *Toona* taxa have been based, occurs throughout the genus with the exception of *T. sinensis*, both inter- and infra-specifically, and even between seedlings of the same population.

Though the monographic revision of these species at the specific level is nearing completion, the floral and vegetative variation observed in the species could represent extreme ranges of polymorphic species, or be genetically stable and eco-geographically correlated, and therefore be given formal recognition. The taxonomy at the infraspecific level is therefore complex and still under review; future conclusions could necessitate some changes in the taxonomy of this genus.

KEY TO THE SPECIES

1a. Bark obnoxiously pungent. Leaflets serrate or dentate. Petal margins, ovary and disk glabrous. Capsule columellas convex without apical scarring. Seeds winged at one end ..... **1. T. sinensis**

b. Bark sweetly aromatic. Leaflets entire. Petal margins ciliate; ovary and disk pilose. Capsule columellas concave with apical scarring. Seeds winged at both ends ... 2

2a. Leaflets usually conspicuously pilose on upper midribs. Flower bud petals usually with dense central ciliate bands externally; styles pilose. Capsule valves usually verrucose with conspicuous rusty lenticels ..... **2. T. sureni**

b. Leaflets usually glabrescent on upper midribs. Flower bud petals glabrescent to sparsely pilose externally; styles glabrous. Capsule valves usually smooth to minutely lenticellate with small inconspicuous lenticels ..... **3. T. ciliata** (and see **3a. T. calantas**)

1. **Toona sinensis** (A. Juss.) M. Roem.

Toona sinensis (A. Juss.) M. Roem., Synops. Monogr. 1 (1846) 139; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 269; Diels, Bot. Jahrb. 29 (1901) 425; Schneider, Illus. Handb. Laubh. 2 (1907) 132; Koord., Exk. Fl. Java 2 (1912) 437; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46; Mitt. Deutsch. Dendrol. Ges. 53 (1941) 183; A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 156; Li, Trop. Woods 79 (1944) 19; Adelb., Blumea 6 (1948) 313; How & Chen, Acta Phytotax. Sin. 4 (1955) 41; Backer & Bakh. f., Fl. Java 2 (1965) 117; Wu, Fl. Yunnan. 1 (1977) 210; L.M. Perry, Med. Plants E & SE Asia (1980) 263; Chen, J. Wuhan Bot. Res. 4 (1986) 186; Bahadur, Monogr. Toona (1988) 115, 124; Mabb. in Tree Fl. Malaya 4 (1989) 256. — *Cedrela sinensis* A. Juss., Bull. Sci. Nat. Géol. 23 (1830) 241; Linnaea 6 (1831) 115; Mém. Mus. Nat. Hist. Nat. 19 (1832) 255; Carrière, Rev. Hort. (1875) 86; C.DC. in DC., Monogr. Phan. 1 (1878) 743; Franchet, Nouv. Arch. Mus. Paris 2, 5 (1884) 220 (Plantae David. 1: 68) ('*chinensis*'); Forbes & Hemsley, J. Linn. Soc. 23 (1886) 114; André, Rev. Hort. (1891) 573; Kuntze, Rev. Gen. Pl. 1 (1891) 111; Backer, Schoolfl. Java (1911) 219; C.DC., Rec. Bot. Surv. India 3 (1908) 360; Shirasawa, Icon. Ess. Flor. Japon. 2 (1908) t. 35, f. 1–13 ('*chinensis*'); Dunn & Tutcher, Bull. Misc. Info. Kew, Add. Ser. 10 (1912) 58; Sargent, Pl. Wilson. 2 (1916) 156; K. Heyne, Nutt. Pl. Ned.-Indië, ed. 1, 3 (1917) 42; Rehder, J. Arnold Arbor. 7 (1926) 189; Burkill, Gard. Bull. Str. Settl. 5 (1930) 121; Makino, J. Jap. Bot. 8 (1932/33) 341; Troup, Exotic Trees (1932) 64; Li, Trop. Woods 79 (1944) 18; Bean, Trees & Shrubs, ed. 8, 1 (1970) 557. — *Surenus sinensis* (A. Juss.) Kuntze, Rev. Gen. Pl. 1 (1891) 111.

Cedrela serrata Royle, Ill. Bot. Him. (1839) 144, t. 25; Brandis, Forest Fl. NW & C India (1874) 73; Kurz, J. As. Soc. Beng. 44, ii (1875) 150; For. Fl. Brit. Burma 1 (1877) 229; C.DC. in DC., Monogr. Phan. 1 (1878) 742; Gamble, Man. Indian Trees (1880) 79; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 204; Kanjilal, Forest Fl. School Circle, NWP (1901) 60; Collett, Fl. Simlensis (1902) 83; Brandis, Indian Trees (1906) 145; C.DC., Rec. Bot. Surv. India 3 (1908) 361; Lace, List Trees Burma (1922) 31; Burkill, Gard. Bull. Str. Settl. 5 (1930) 121; Troup, Exotic Trees (1932) 64; Midon, Malays. For. Serv. Trade Leaflet 93 (1985). — *Toona serrata* (Royle) M. Roem., Synops. Monogr. 1 (1846) 139; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 269; Briq., Mém. Inst. Nat. Genev. 24 (1935) 31; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 47; A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 158; Hara & Williams, Enum. Flow. Pl. Nepal 2 (1979) 86; Stainton, Flowers Himal. (1988) 11; Styles & White, Flora Trop. East Africa, Meliaceae (1991) 46. — *Surenus serrata* (Royle) Kuntze, Rev. Gen. Pl. 1 (1891) 111.

Mioptrila odorata Raf., Am. Man. Mulb. Trees (1839) 37, nom. provis., excl. fol. (= *Zanthoxylum sp.*).

Toona longifolia [Wall. ex M. Roem., Synops. Monogr. 1 (1846) 140, nom. nud., ex] Harms in Engl. & Prantl, Nat. Pflanzenfam., ed 2, 19b1 (1940) 46.

Cedrela serrulata Miq., Fl. Ind. Bat., Suppl. (1861) 508; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 64; C.DC. in DC., Monogr. Phan. 1 (1878) 746. — *Surenus serrulata* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 111. — *Toona serrulata* (Miq.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 269; ibid., ed. 2, 19b1 (1940) 46.

Ailanthus flavescens Carrière, Rev. Hort. (1865) 366 ('*Ailantus*').

Cedrela glabra C.DC. in DC., Monogr. Phan. 1 (1878) 742; Blanco, Fl. Filip. 4, Nov. App. (1880) 45. — *Surenus glabra* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 111. — *Toona glabra* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 269; Panigrahi, Bangl. J. Bot. 3 (1974) 54. — [*Cedrela longifolia* Wall., Cat. (1829) n. 1273, nom. nud. ex C.DC., Rec. Bot. Surv. India 3 (1908) 375, nom. superfl. pro *Cedrela glabra.*] — *Toona sinensis* (A. Juss.) M. Roem. var. *glabra* (C.DC.) Bahadur, Monogr. Toona (1988) 120.

Cedrela longifolia Wall. ex C.DC. var. *kumaona* C.DC., Rec. Bot. Surv. India 3 (1908) 376.

Cedrela serrata Royle var. *puberula* C.DC., Rec. Bot. Surv. India 3 (1908) 363. — *Toona sinensis* (A. Juss.) M. Roem. var. *puberula* (C.DC.) Bahadur, Monogr. Toona (1988) 122.

Cedrela sinensis A. Juss. var. *hupehana* C.DC., Rec. Bot. Surv. India 3 (1908) 361. — *Toona sinensis* (A. Juss.) M. Roem. var. *hupehana* (C.DC.) A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 156.

Cedrela sinensis A. Juss. var. *schensiana* C.DC., Rec. Bot. Surv. India 3 (1908) 361; Li, Trop. Woods 79 (1944) 19. — *Toona sinensis* (A. Juss.) M. Roem. var. *schensiana* (C.DC.) Wu, Fl. Yunnan. 1 (1977) 210, comb. invalid.?; X.M. Chen, J. Wuhan Bot. Res. 4 (1986) 187.

Toona sinensis (A. Juss.) M. Roem. var. *grandis* Pamp., Nuov. Giorn. Bot. Ital. 18 (1911) 171; A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 156.

Cedrela sinensis A. Juss. var. *lanceolata* Li, Trop. Woods 79 (1944) 19.

Toona microcarpa (C.DC.) Harms var. *denticulata* A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 158. — *Toona sinensis* (A. Juss.) M. Roem. var. *denticulata* (A. Chev.) Bahadur, Monogr. Toona (1988) 118.

Toona microcarpa (C.DC.) Harms var. *grandifolia* A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 158. — *Toona sinensis* (A. Juss.) M. Roem. var. *grandifolia* (A. Chev.) Bahadur, Monogr. Toona (1988) 121.

Toona sinensis (A. Juss.) M. Roem. var. *incarvillei* A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 156.

Tree to 40 m; bole to 20 m and girth to 150 cm, buttressed. Bark grey to dark brown, fissured; inner bark pink to red, fibrous; sapwood cream, fibrous; smelling strongly of garlic and pepper when cut. *Leaves* 32–120 cm long, usually 8–20-jugate; rachides glabrous to pilose, often reddish; petioles 5.5–20 cm long, glabrous to pilose. *Leaflets* narrowly lanceolate to linear-lanceolate, serrate or serrulate, rarely entire, 11–22 by 3–5.6 cm, glabrous to pilose, especially on the midribs and veins, club-shaped glandular

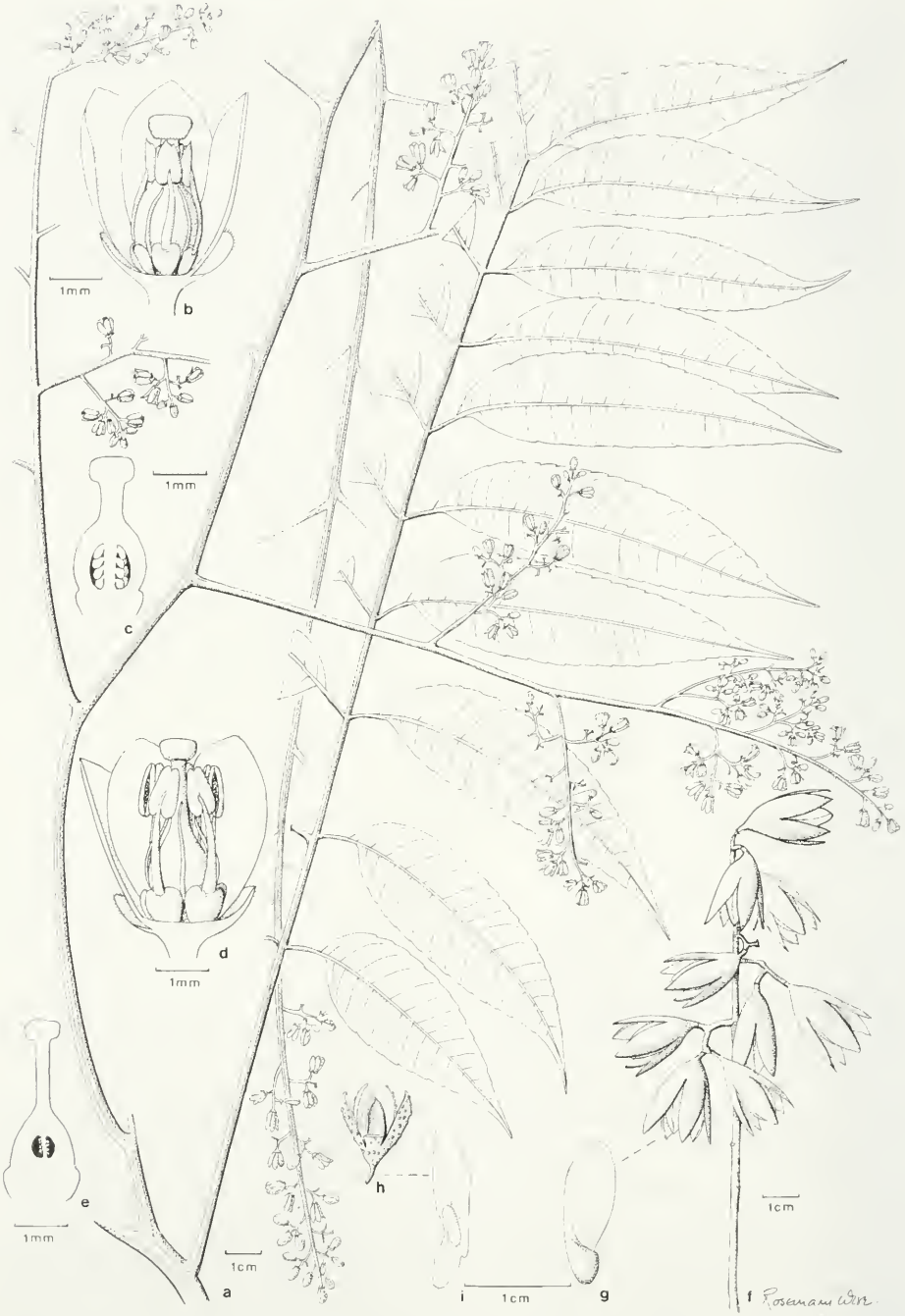

Fig. 54. *Toona sinensis* (A. Juss.) M. Roem. a. Leaf and inflorescence; b. female flower; c. ditto with ovules; d. male flower; e. ditto with vestigeal ovules; c & e in longitudinal section; f. infructescence with open capsules; g. seed (a: *Lace 961*; b, c: *Symington 30980*; d, e: *Whitmore 20098*; f, g: *Clemens 6218*). — *T. sureni* (Blume) Merr. h. Open capsule; i. seed (h, i: *Boschproefstation 11976*). Drawing R. Wise.

hairs conspicuous on upper midrib areas and junctions between leaf rachides and petiolules, apex acuminate, base asymmetric; petiolules 3–9 mm long, glabrescent. *Inflorescences* up to 1 m, pendent, rachides glabrescent, pilose or villous with short appressed or spreading simple hairs; pedicels c. 0.5 mm, glabrescent to pilose. *Flowers* 3.5–4.5 mm long. *Calyx* cupulate, 1–1.5 mm long, glabrous externally; sepals 0.5–1.1 by 0.6–1.75 mm, margins ciliate. *Petals* white or flushed pink, 2.8–4.2 by 1.1–2.9 mm, glabrous externally, margins non-ciliate. *Androgynophore* 2.5–4 mm long, glabrous. *Staminodes* always present, usually 5, sometimes 1–4, 0.75–1.75 mm long, glabrous. Filaments 1.3–1.75 mm long (male flowers), 1–1.5 mm long (female flowers), glabrous. Anthers 0.8–1.2 mm long, 0.5–0.75 mm broad. Antherodes 0.3–0.8 mm long, 0.3–0.5 mm broad, apices apiculate, sometimes extended. *Disk* 1–1.5 mm diam., orange, glabrous. *Ovary* 1.6–2.25 mm diam., glabrous; locules to 6-ovulate. Style 1.1–1.5 mm long, 0.5 mm broad (male), 0.5–0.8 mm long, 0.3–0.4 mm broad (female), glabrous; stylehead 0.5–1 mm diam. *Capsule* 15–30 mm long; columella 12–29 mm long, 6–11 mm broad, convex; valves reddish to dark brown, 15–30 by 4–7 mm, elenticellate and smooth to punctate with small (0.3–0.5 mm diam.) scattered lenticels. *Seeds* winged at one end, 8–16 by 3.5–6.2 mm; seed body 8–10 by 1.7–4 mm. — **Fig. 54a–g.**

Distribution — Highlands of tropical Asia from India, Nepal and China through Burma, Thailand to *Malesia:* Sumatra (W & E Coast, Palembang, Tapanuli), Peninsular Malaysia (Perak, Pahang), Borneo (Sabah), Java (Preanger, Cibodas, Mt Merbabu). It is planted in India and Sri Lanka for shade, and in various European cities (e.g. Paris, where introduced via Japan in 1862, the original tree in the rue Buffon being felled in the 1970s) as an avenue tree.

Habitat — An upland species (350–2000 m altitude), usually confined to primary montane forests, where it is found on light, steep hillside slopes often near streams; also occurring in secondary forests and disturbed sites.

Vernacular names — Peninsular Malaysia: surian bawang, surian wangi; Borneo (Sabah): rangau (Dusun), limpaga (Malay); Sumatra: ingaal; Java & Sumatra: soeren, soerian, suren.

Uses — The timber is used for furniture and sieve hoop making, and in bridge construction. The leaves are used as food in China and Malaysia, and as animal fodder in India (Burkill 1930). The trees are widely used medicinally, with the bark being used as an astringent and depurative; powdered root as a refreshment and a diuretic, and tender leaves as a carminative (Perry 1980). Cultivated plants in Europe include cv. Flamingo with brightly coloured young leaves.

Note — The leaf morphology and indumentum types and density are particularly variable in this species, with capsule valve form also showing some variability. On the basis of such features, eight infraspecific variants have been recognized by other authors.

2. **Toona sureni** (Blume) Merr.

Toona sureni (Blume) Merr., Interpr. Rumph. Herb. Amb. (1917) 305; Enum. Philipp. Flow. Pl. 2 (1923) 357; Merr. & Chun, Sunyatsenia 1 (1930) 62; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 45; Adelb., Blumea 6 (1948) 313; How & Chen, Acta Phytotax. Sin. 4 (1955)

39; Backer & Bakh. f., Fl. Java 2 (1965) 117; Hara & Williams, Enum. Flow. Pl. Nepal (1979) 86; L.M. Perry, Medic. Pl. E & SE Asia (1980) 263; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 345, t. 264; Bahadur, Monogr. Toona (1988) 129; Mabb. in Tree Fl. Malaya 4 (1989) 258. — *Swietenia sureni* Blume, Cat. Gew. Buitenzorg (1823) 72. — *Cedrela sureni* (Blume) Burkill, Gard. Bull. Str. Settl. 5 (1930) 121; Dict. Econ. Prod. Malay Penins. (1935) 499.

[*Surenus rubra* Rumph., Herb. Amb. 3 (1750) t. 39; cf. Hassk., Neue Schluss. Rumph. Herb. Amb. (1886) 51.]

[*Azederach recisa* Noronha, Verh. Batav. Gen., ed. 5, 1 (1790/91) art. 4, 5 ('*recisum*'), nom. nud.; cf. Mabb., Gard. Bull. Sing. 37 (1984) 62.]

Cedrela febrifuga Blume, Verh. Batav. Gen. 9 (1823) 135; Bijdr. (1825) 180; Nees, J. Pharm. 11 (1825) 518; Sprengel, Syst. Veg., ed. 16, 4 (1827) 95; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris (1830) 255; G. Don, Gen. Syst. 1 (1831) 687; Forsten, Diss. Cedrela febrifuga, Univ. Leiden (1836) 18; Hassk., Hort. Bogor. Descr. (1858) 129; Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 63; C.DC. in DC., Monogr. Phan. 1 (1878) 744; King, J. As. Soc. Beng. 64, ii (1895) 89; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 197; Brandis, Indian Trees (1906) 146; C.DC., Rec. Bot. Surv. India 3 (1908) 372; Backer, Schoolfl. Java (1911) 219; K. Heyne, Nutt. Pl. Ned.-Indië, ed. 1, 3 (1917) 40; Lace, Trees Shrubs Burma (1922) 31; Ridley, Fl. Malay Penins. 1 (1922) 415. — *Toona febrifuga* (Blume) M. Roem., Synops. Monogr. 1 (1846) 139; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 269; Pierre, Fl. For. Cochinch. 5, fasc. 23 (1897) t. 358; Pellegr. in Fl. Indo-Chine 1 (1911) 793; Koord., Exk. Fl. Java 2 (1912) 437; Atlas 1 (1913) f. 168; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46. — *Surenus febrifuga* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 111.

Cedrela febrifuga Blume var. *assamensis* C.DC., Rec. Bot. Surv. India 3 (1908) 373; Burkill, Rec. Bot. Surv. India 10 (1925) 257.

Cedrela febrifuga Blume var. *glabrior* C.DC. in DC., Monogr. Phan. 1 (1878) 744, p.p.; Rec. Bot. Surv. India 3 (1908) 373; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 199. — ?*Toona febrifuga* M. Roem. var. *glabrior* (C.DC.) Pierre, Fl. For. Cochinch. 5, fasc. 23 (1897) t. 358, p.p.; Pellegr. in Fl. Indo-Chine 1 (1911) 794.

Cedrela febrifuga Blume var. *pealii* C.DC., Rec. Bot. Surv. India 3 (1908) 374.

?*Cedrela febrifuga* Blume var. *verrucosa* C. DC., l.c.

?*Cedrela toona* Roxb. ex Rottl. & Willd. var. *pilistila* C.DC., Rec. Bot. Surv. India 3 (1908) 365.

Cedrela toona Roxb. ex Rottl. & Willd. var. *pilistaminea* C.DC., op. cit. (1908) 366, p.p.

Cedrela toona Roxb. ex Rottl. & Willd. var. *yunnanensis* C. DC., l.c. — *Toona ciliata* M. Roem. var. *yunnanensis* (C.DC.) C.Y. Wu, Fl. Yunnan. 1 (1977) 207, ?nom. superfl.; Chen, J. Wuhan Bot. Res. 4 (1986) 187.

?*Cedrela toona* Roxb. ex Rottl. & Willd. var. *henryi* C.DC., Rec. Bot. Surv. India 3 (1908) 369. — *Toona ciliata* M. Roem. var. *henryi* (C.DC.) C.Y. Wu, Fl. Yunnan. 1 (1977) 209, ?nom. superfl.

?*Cedrela toona* Roxb. ex Rottl. & Willd. var. *warburgii* C.DC., Rec. Bot. Surv. India 3 (1908) 370.

Cedrela microcarpa C.DC. var. *grandifoliola* C.DC., op. cit. (1908) 371. — *Toona ciliata* M. Roem. var. *grandifoliola* (C.DC.) Bahadur, Monogr. Toona (1988) 91.

?*Toona ciliata* M. Roem. var. *candollei* Bahadur, Monogr. Toona (1988) 99.

Toona ciliata M. Roem. var. *hainesii* (C.DC.) Panigrahi & Mishra, Ind. J. For. 11 (1988) 141, p.p.

Toona microcarpa (C.DC.) Harms var. *pilipetala* (C.DC.) Bahadur, Monogr. Toona (1988) 113, p.p.

?*Toona microcarpa* (C.DC.) Harms var. *sahnii* Bahadur, Monogr. Toona (1988) 114.

Medium- to large-sized tree to 40 m tall and > 3 m girth; bole to 25 m, with or without buttresses (to 2 m); crown fairly wide, spreading, occasionally dense. Bark whitish, grey-brown, grey or light-brown, usually vertically fissured and flaking; inner bark pinkish-white, -brown, reddish-brown or -orange, fibrous; sapwood white, pink or pale red; sweetly aromatic when cut. *Twigs* often prominently lenticellate with verrucose lenticels. *Leaves* 29–84 cm long, usually 6–9(–12)-jugate; rachides glabrescent to moderately pilose, occasionally velutinous; petioles 7–12 cm long, glabrescent to pilose,

Fig. 55. *Toona* trees, probably *T. sureni* (Blume) Merr., planted for shade and roadside boundary in Central Java. Provenance of photograph not known.

often lenticellate. *Leaflets* lanceolate to ovate-lanceolate, margins entire, 7–14(–19.5) by 3–6(–7) cm, glabrescent to moderately pilose, usually with short hairs and club-glands on the upper midribs, lower vascular system pilose, apices acuminate, occasionally acute, bases symmetrical to asymmetrical; petiolules (0.2–)0.4–1.2 cm long, glabrescent to pilose/villous. *Inflorescences* up to 40 cm long, pendent, sweetly aromatic; rachides pilose to villous with medium to long spreading hairs, occasionally glabrescent; pedicels (0.3–)0.75–1.25 mm long, pilose to villous. *Flowers* 4–5 mm long. *Calyx* 1–1.5 mm long, glabrescent to pilose externally, lobes imbricate; sepals usually triangular, especially in bud, 0.6–1 by 0.8–1.5 mm, glabrescent to villous externally, apices usually acute, margins ciliate. *Petals* white, creamy-white or pinkish, 3.5–5 by 1.6–3.2 mm, glabrescent to villous, but usually with conspicuous central bands of long appressed hairs in bud, margins ciliate with long hairs. *Androgynophore* 2.5–4.7 mm long. *Filaments* 1.25–2.5 mm long (male flowers), 1–1.3 mm long (female flowers), pilose to villous with scattered to dense long hairs. Anthers 0.75–1.25 mm long, 0.3–0.8 mm broad, apices usually apiculate. Antherodes 0.5–0.9 mm long, 0.25–0.6 mm broad, sagittate. *Disk* 1.25–2.5 mm diam., orange to red, densely pilose. *Ovary* 1.6–2.75 mm diam., moderately to densely pilose; locules to 6-ovulate. Style 1.25–3 mm long, 0.25–0.5 mm broad (male), 0.5–1 mm long, c. 0.3 mm broad (female), pilose with scattered

usually appressed hairs especially on the lower half; stylehead 0.75–1.25 mm diam. *Capsule* 14–20(–24) mm long; columella 14–20(–24) mm long, 5–8(–10) mm broad, concave with apical scarring; valves dark- to blackish-brown, rough, verrucose with conspicuous, often ovate rusty lenticels, 0.3–2 by 0.4–1.25 mm. *Seeds* winged at both ends, 11–20(–22) by (3–)4–4.8 mm, wings unequal with broadly obtuse apices; seed body 5–8 by 1.5–2 mm. — **Fig. 54h, i, 55.**

Distribution — From India, through Nepal, Bhutan, Burma, S China, Thailand to *Malesia:* Sumatra (W Coast, Tapanuli, Lampongs, Madailing, Karolands), Peninsular Malaysia (Selangor, Pahang, Kelantan, Kedah, Perlis, Penang, Langkawi, Mersing, Aur), Borneo (Sabah, Sarawak, Kalimantan), Java (W & E), Lesser Sunda Islands (Bali, Sumba, Timor), Moluccas (Halmahera, Tanimbar), Celebes (N, Kawata, Amurang), New Guinea (Irian Jaya: Kebar Valley; Papua New Guinea: Chimbu Valley).

Habitat — Common to rare, in primary and secondary forests, often in logged and disturbed areas, usually on riparian hillsides or slopes, from sea-level to 1700 m altitude.

Vernacular names — Sumatra: serijan (Lampongs), ?para, soerian amba, ingoe; Malay Peninsula: soren, surian, surian wangi, ?tangipan burang; Borneo (Kalimantan): suren, ?mesal; Java: kiketaro, odjang, soren, soeren, soeren keling, suren (Madura), redani; New Guinea: boerwam, moeroewan (Kebar), ongguno (Kuman), muwa (Maring); Philippines, official common name: danupra.

Uses — The timber is said to be 'excellent' (Don 1832). Medicinally, the bark is used as a powerful astringent and a purative throughout its range [see Horsfield, Verh. Batav. Gen. Wet. 8 (1816) 125]; in Indochina it is considered to be a tonic, an antiperiodic and an antirheumatic, while in Indonesia it is used as an astringent and a tonic for treating diarrhoea, dysentery and other intestinal infections. Leaf extracts apparently have an antibiotic activity against *Staphylococcus*, with leaf tip concoctions being applied to swellings (Perry 1980).

Note — There are several large-fruited variants of this species, whose taxonomic status has yet to be determined. The most striking was described as *Cedrela celebica* Koord. [Minah. (1898) 636] from NE Celebes, where it is known as 'lalumpehe'. Flowers of this variant are rarely collected, but its capsules are morphological enlargements of those found in *T. sureni*. They exhibit the following characteristics: 35–42 mm long; columellas 29–38 mm long, 13–18 mm broad, valves verrucose, 36–41 by 9–11 mm, with large rusty lenticels 0.75–1.25 mm diam.; seeds 18–29 by 6–9 mm. The tree is used for furniture manufacture, and in house and boat construction. Whether it is merely a large-fruited variant of *T. sureni* or a distinct geographical taxon remains to be resolved.

3. **Toona ciliata** M. Roem.

Toona ciliata M. Roem., Synops. Monogr. 1 (1846) 139; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 270; Merr., Dept. Int. For. Bur. Bull. 1 (1902) 27; Bull. Dept. Agric. Nat. Res. Bur. For. Philipp. 1 (1903) 27; Briq., Mém. Inst. Nat. Genev. 24 (1935) 32; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 45; Kitamura in Kihara, Fauna & Flora Nepal Himal. 1

(1955) 170; Wu, Fl. Yunnan. 1 (1977) 207; Hara & Williams, Enum. Flow. Pl. Nepal 2 (1979) 85; Chen, J. Wuhan Bot. Res. 4 (1986) 187; Panigrahi & Mishra, Ind. J. For. 11 (1988) 140; Bahadur, Monogr. Toona (1988) 64; Styles & White, Fl. Trop. E Afr., Meliaceae (1991) 45; Taylor & Harden in Harden (ed.), Fl. NSW 2 (1991) 279. — *Cedrela toona* Roxb. ex Rottl. & Willd., Neue Schr. Naturf. Freunde Berlin 4 (1803) 198; Roxb., Hort. Bengal. (1814) 18; Plant. Coromand. 3 (1819) 33; Roem. & Schultes, Syst. Veg. 5 (1819) 464; DC., Prodr. 1 (1824) 624; Roxb., Fl. Ind. 2 (1824) 423; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 255; G. Don, Gen. Syst. 1 (1831) 687; Wight & Arn., Prodr. 1 (1834) 124; Wight, Ic. 1 (1840) pl. 161; Hassk., Hort. Bogor. Descr. (1858) 127; Miq., Fl. Ind. Bat. 1 (1859) 548; Suppl. (1861) 197; Dalzell & Gibson, Bombay Fl. (1861) 38; Benth., Fl. Austral. 1 (1863) 387; Bedd., Fl. Sylv. S Ind. 1 (1869) 10; Hiern in Hook. f., Fl. Brit. India 1 (1872) 568; Brandis, For. Fl. NW & C India (1874) 72; Kurz, For. Fl. Brit. Burma 1 (1877) 228; C.DC. in DC., Monogr. Phan. 1 (1878) 745; Gamble, Man. Ind. Trees (1880) 77; Blanco, Fl. Filip. 4, Nov. App. (1880); Franchet, Bull. Soc. Bot. Fr. 33 (1886) 452; Talbot, Trees Shrubs Bombay (1894) 42; ed. 2 (1902) 80; Kanjilal, For. Fl. School Circle, NWP (1901) 60; Collett, Fl. Simlensis (1902) 83; Cooke, Fl. Pres. Bombay 1 (1903) 217; Duthie, Fl. Upper Gang. Plain 1 (1903–05) 153; Brandis, Indian Trees (1906) 145; C.DC., Rec. Bot. Surv. India 3 (1908) 364; Haines, For. Fl. Chota Nagpur (1910) 249; Burkill, Rec. Bot. Surv. India 4 (1913) 102; Haines, Bot. Bihar & Orissa 2 (1921) 174; Lace, Trees Shrubs Burma (1922) 32; Craib, Fl. Siam. Enum. 1 (1926) 267; Burkill, Gard. Bull. Str. Settl. 5 (1930) 121; Troup, Exotic Trees (1932) 65; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 500; Li, Trop. Woods 79 (1944) 22. — [*Swietenia toona* Stokes, Bot. Mat. Med. 2 (1812) 480, nom. nud., '*Suitenia toon*'.] — *Cedrela australis* Mudie, Pict. Austral. (1829) 147, nom. superfl. pro *C. toona*; cf. Mabb., Austral. Syst. Bot. Soc. Newsl. 70 (1992) 14. — *Surenus toona* (Rottl. & Willd.) Kuntze, Rev. Gen. Pl. 1 (1891) 111.

?*Cedrela velutina* DC., Prodr. 1 (1824) 625; G. Don, Gen. Syst. 1 (1831) 687; C.DC. in DC., Monogr. Phan. 1 (1878) 747. — ?*Toona velutina* (DC.) M. Roem., Synops. Monogr. 1 (1846) 139. — ?*Surenus velutina* (DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 111. — ?*Toona ciliata* M. Roem. subsp. *velutina* (DC.) Bahadur, Monogr. Toona (1988) 97.

Cedrela hexandra Wall. in Roxb., Fl. Ind. (1824) 425, nom. in obs.; Aitken, Trans. Soc. Arts 48 (1833) 448. — *Toona hexandra* (Wall.) M. Roem., Synops. Monogr. 1 (1846) 139. — *Toona ciliata* M. Roem. var. *hexandra* (Wall.) Bahadur, Monogr. Toona (1988) 93.

Cedrela australis F. Muell., Fragm. Phyt. Austral. 1 (1858) 4, non Mudie; C.DC. in DC., Monogr. Phan. 1 (1878) 743. — *Surenus australis* Kuntze, Rev. Gen. Pl. 1 (1891) 111. — *Toona australis* Harms in Engl. & Prantl., Nat. Pflanzenfam. 3, 4 (1896) 270; Briq., Mém. Inst. Nat. Genev. 24 (1935) 31.

?*Cedrela teysmannii* Hassk., Hort. Bogor. 1 (1858) 133; Miq., Fl. Ind. Bat. 1, 2 (1859) 549; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 63; C.DC. in DC., Monogr. Phan. 1 (1878) 747 — *Surenus teysmannii* (Hassk.) Kuntze, Rev. Gen. Pl. 1 (1891) 111. — ?*Toona sureni* (Blume) Merr. var. *teysmannii* (Hassk.) Bahadur, Monogr. Toona (1988) 143.

Cedrela toona Roxb. ex Rottl. & Willd. var. *parviflora* Benth., Fl. Austral. 1 (1863) 387; C.DC., Rec. Bot. Surv. India 3 (1908) 368. — *Toona ciliata* M. Roem. var. *parviflora* (Benth.) Bahadur, Monogr. Toona (1988) 94.

Cedrela febrifuga Blume f. *ternatensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 63. — *Toona ternatensis* (Miq.) Bahadur, Monogr. Toona (1988) 144.

Cedrela febrifuga Blume f. *timorensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 63.

Cedrela microcarpa C.DC. in DC., Monogr. Phan. 1 (1878) 745; Rec. Bot. Surv. India 3 (1908) 370; Brandis, Indian Trees (1906) 145; Lace, Trees Shrubs Burma (1922) 31; Craib, Fl. Siam. Enum. 1 (1926) 267; Chun, Fl. Kwantung (1934) 257; Merr. & Metcalfe, Lingn. Sc. J. 16 (1937) 196; Li, Trop. Woods 79 (1944) 20. — *Surenus microcarpa* (C.DC.) Kuntze, Rev. Gen. Pl. 1 (1891) 111. — *Toona microcarpa* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 270; Pellegr. in Fl. Indo-Chine 1 (1911) 795; Briq., Mém. Inst. Nat. Genev. 24 (1935) 32; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46; How & Chen, Acta Phytotax. Sin. 4 (1955) 40; Wu, Fl. Yunnan. 1 (1977) 209; Hara & Williams, Enum. Flow. Pl. Nepal (1979) 86; Chen, J. Wuhan Bot. Res. 4 (1986) 188; Bahadur, Monogr. Toona (1988) 109.

Cedrela toona Roxb. ex Rottl. & Willd. var. *pubescens* Franch., Bull. Soc. Bot. Fr. 33 (1886) 452; Pl. Delav. (1889) 126; C.DC., Rec. Bot. Surv. India 3 (1908) 369; Li, Trop. Woods 79 (1944) 24. — *Toona ciliata* M. Roem. var. *pubescens* (Franch.) Hand.-Mazz., Symb. Sin. 7 (1933) 631; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 45; Wu, Fl. Yunnan. 1 (1977) 207; Chen, J. Wuhan Bot. Res. 4 (1986) 187. — *Toona sureni* (Blume) Merr. var. *pubescens* (Franch.) Chun in How & Chen, Acta Phytotax. Sin. 4 (1955) 40.

Toona febrifuga (Blume) M. Roem. var. *cochinchinensis* Pierre, Fl. For. Cochinch. 5, 23 (1897) t. 358; Pellegr. in Fl. Indo-Chine 1 (1911) 795. — *Cedrela febrifuga* Blume var. *cochinchinensis* (Pierre) C.DC., Rec. Bot. Surv. India 3 (1908) 374. — *Toona sureni* (Blume) Merr. var. *cochinchinensis* (Pierre) Bahadur, Monogr. Toona (1988) 135.

Toona febrifuga (Blume) M. Roem. var. *griffithiana* Pierre, Fl. For. Cochinch. 5 (1897) 23, t. 358.

Toona febrifuga (Blume) M. Roem. var. *ternatensis* Pierre, Fl. For. Cochinch. 5 (1897) 23.

?*Cedrela hainesii* C.DC., Rec. Bot. Surv. India 3 (1908) 363, p.p. — ?*Toona hainesii* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 47, p.p.; Bahadur, Monogr. Toona (1988) 108. — ?*Cedrela toona* Roxb. ex Rottl. & Willd. var. *hainesii* (C.DC.) Haines, Bot. Bihar & Orissa 2 (1921) 174. — *Toona ciliata* M. Roem. var. *hainesii* (C.DC.) Panigrahi & Mishra, Ind. J. For. 11 (1988) 141, p.p.

Cedrela toona Roxb. ex Rottl. & Willd. var. *latifolia* Miq. ex C.DC., Rec. Bot. Surv. India 3 (1908) 365. — *Toona ciliata* M. Roem. var. *latifolia* (C.DC.) Chandr., Biol. Mem. 2 (1977) 28.

Cedrela toona Roxb. ex Rottl. & Willd. var. *nepalensis* C.DC., Rec. Bot. Surv. India 3 (1908) 365. — *Toona ciliata* M. Roem. subsp. *nepalensis* (C.DC.) Panigrahi, Bangl. J. Bot. 3 (1974) 54.

Cedrela toona Roxb. ex Rottl. & Willd. var. *cuspidata* C.DC., Rec. Bot. Surv. India 3 (1908) 366, p.p.

Cedrela toona Roxb. ex Rottl. & Willd. var. *pilistaminea* C.DC., l.c., p.p.

Cedrela toona Roxb. ex Rottl. & Willd. var. *gamblei* C.DC., Rec. Bot. Surv. India 3 (1908) 367.

Cedrela toona Roxb. ex Rottl. & Willd. var. *pilipetala* C.DC., l.c., p.p. — *Toona microcarpa* (C.DC.) Harms var. *pilipetala* (C.DC.) Bahadur, Monogr. Toona (1988) 113, p.p.

Cedrela toona Roxb. ex Rottl. & Willd. var. *stracheyi* C.DC., Rec. Bot. Surv. India 3 (1908) 367.

Cedrela toona Roxb. ex Rottl. & Willd. var. *talbotii* C.DC., l.c.

Cedrela toona Roxb. ex Rottl. & Willd. var. *australis* C.DC., Rec. Bot. Surv. India 3 (1908) 368; Lane-Poole, For. Res. Papua New Guinea (1925) 100 ('*Cedrella*'). — *Toona ciliata* M. Roem. var. *australis* (C.DC.) Bahadur, Monogr. Toona (1988) 78, nom. invalid.

Cedrela toona Roxb. ex Rottl. & Willd. var. *pubinervis* C.DC., Rec. Bot. Surv. India 3 (1908) 368. — *Toona ciliata* M. Roem. var. *pubinervis* (C.DC.) Bahadur, Monogr. Toona (1988) 96.

Cedrela toona Roxb. ex Rottl. & Willd. var. *puberula* C.DC., Rec. Bot. Surv. India 3 (1908) 369.

Cedrela toona Roxb. ex Rottl. & Willd. var. *sublaxiflora* C.DC., l.c. — *Toona ciliata* M. Roem. var. *sublaxiflora* (C.DC.) C.Y. Wu, Fl. Yunnan. 1 (1977) 209.

Cedrela kingii C.DC., Rec. Bot. Surv. India 3 (1908) 371. — *Toona kingii* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46. — *Toona ciliata* M. Roem. var. *kingii* (C.DC.) Bahadur, Monogr. Toona (1988) 100.

Cedrela kingii C.DC. var. *birmanica* C.DC., Rec. Bot. Surv. India 3 (1908) 372.

?*Cedrela mannii* C.DC., Rec. Bot. Surv. India 3 (1908) 374. — ?*Toona mannii* (C.DC.) Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46.

Cedrela toona Roxb. ex Rottl. & Willd. var. *hasletii* Haines, For. Fl. Chota Nagpur (1910) 250; Bot. Bihar & Orissa 2 (1921) 174. — *Toona ciliata* M. Roem. var. *hasletii* (Haines) Panigrahi & Mishra, Ind. J. For. 11 (1988) 141. — *Toona ciliata* M. Roem. var. *hasletii* (Haines) Bahadur, Monogr. Toona (1988) 92 ('*haslettii*').

Cedrela toona Roxb. ex Rottl. & Willd. var. *vestita* C.T. White, Queensl. Agr. J. 13 (1920) 66. — *Toona ciliata* M. Roem. var. *vestita* (C.T. White) Bahadur, Monogr. Toona (1988) 106.

Cedrela mollis Hand.-Mazz., Anzeig. Akad. Wiss. Wien 57 (1920) 266. — *Toona mollis* (Hand.-Mazz.) A. Chev., Rev. Bot. Appl. Agr. Trop. 24 (1944) 157. — *Toona ciliata* M. Roem. var. *mollis* (Hand.-Mazz.) Bahadur, Monogr. Toona (1988) 101.

Cedrela toona Roxb. ex Rottl. & Willd. var. *multijuga* Haines, Bot. Bihar & Orissa 2 (1921) 174.

Cedrela brevipetiolulata Haines, Bot. Bihar & Orissa 1 (1921) 174, nom. provis. — *Toona ciliata* M. Roem. var. *brevipetiolulata* (Haines) Mishra & Panigrahi, Ind. J. For. 11 (1988) 140.

Medium- to large-sized tree to 35 m tall and 152 cm girth; bole to 22 m, with or without buttresses (to 3.5 m); crown usually rounded and spreading, occasionally dense. Bark greyish-white to brown, usually fissured and flaking; inner bark brown to reddish, fibrous; sapwood white to pink or red; smelling strongly of cedar when cut. *Leaves* (15–)26–69 cm long, usually (5–)9–15-jugate; rachides glabrous to sparsely pilose, often reddish; petioles 6–11 cm long, glabrous to pilose. *Leaflets* lanceolate to ovate-lanceolate, margins entire, (7–)9–12.8(–16) by (2.2–)3.2–5(–6) cm, glabrescent with hairs on upper midribs rare, apex acute to acuminate, base usually asymmetric; petiolules 0.2–1(–1.4) cm long, glabrescent. *Inflorescences* up to 55 cm, pendent, fragrant; rachides pilose to pilose-villous with short to long, spreading or appressed hairs; pedicels 0.5–1 mm, usually pilose, occasionally villous. *Flowers* 3.5–5(–6) mm long. *Calyx* 0.75–1.25 mm long, usually glabrescent externally, lobes imbricate; sepals spathulate, (0.4–)0.75–1 by (0.5–)0.75–1.25 mm, margins ciliate. *Petals* white to creamy-white, 3.5–5.8 by 1.3–3.1 mm, usually glabrescent occasionally pilose externally, margins ciliate with long hairs. *Androgynophore* (1.75–)3–4.9(–5.5) mm long. *Filaments* 1.25–2.5 mm long (male flowers), 0.75–1.75 mm (female flowers), glabrous to pilose/villous. Anthers 0.6–1.1 mm long, 0.4–0.9 mm broad, apices usually apiculate, often with long appendage. Antherodes 0.5–0.9 mm long, 0.3–0.6 mm broad, usually sagittate, often with long apiculate appendage. *Disk* 1.25–2.5 mm diam., reddish-orange, densely pilose. *Ovary* 1.25–1.8 mm diam., moderately pilose; locules to 8-ovulate. Style 1.2–3 mm long, 0.2–0.4 mm broad (male), 0.3–1.5 mm long, c. 0.3 mm broad (female), glabrous; stylehead 0.75–1.25 mm diam. *Capsule* 15–20(–25) mm long; columella 15–20(–24) mm long, 5–7(–10) mm broad, concave with apical scarring; valves reddish-brown, smooth to lenticellate with small (0.1–0.5 mm diam.) scattered lenticels. *Seeds* winged at both ends, 11–19 by 2.5–4(–5.8) mm, wings unequal, apices narrowly obtuse; seed body 5–7 by 1.2–3 mm.

Distribution — Widely distributed within the generic range, from Pakistan through India, Bangladesh, South China, Burma, Thailand to *Malesia:* Sumatra (East & West Coast, Lampongs), Bangka Islands, Peninsular Malaysia (Perak, Kedah, Langkawi), Borneo (Sabah), Java (W, C & E), Philippines (Luzon, Mindoro), Celebes, Lesser Sunda Islands (Flores, Timor), Moluccas (Ternate, Tanimbar), New Guinea (Irian Jaya: Manokwari; Papua New Guinea: Morobe Prov., Koitani, Yalu, Moresby Distr.). Also in New Britain and eastern Australia. Commonly cultivated as an avenue tree in India.

Habitat — Common to scarce, in primary and disturbed, often riparian, rain forests from sealevel to 1500 m altitude, occasionally higher.

Vernacular names — Sumatra: ingoe (?), serian (Lampongs), limprah, taal-batak (Karo), gerpa, ? keritang; Malaya: suryan, surian; Java: soeren, soeren-kapar, ?ki bewan, suren batu (Djasilin), soeren-mal, beroeh; Timor: hoerenii, surian (Dawan), ai seriq (Tetum), hao lonis; Sabah: surian-limpaga, limpaga (Kwijau), ranggoh (Dusun); Celebes: malapoga (Baree lang.), mapala (Koemea); Moluccas: kukoru, maroa, ladeje (Otimmer); Philippines: danupra; New Guinea: boerwaan (Kebar), djoer-er (Tor), ibio (Manikiong), seba (Mooi), maroa, mafus (Yalu), soi (Waria).

Uses — The timber is highly valued, especially in India and Australia; it is used in house and boat construction, for high grade furniture and carvings, and to make tea-chests, oil casks, pencils, musical instruments. The flowers are used as a source of red and yellow dyes for silk, cotton and wool fabrics and as an emmenagogue. The leaves and young shoots are lopped for cattle fodder in India. Various parts are used medicinally throughout its geographical range; the bark is a powerful astringent, a tonic and an antiperiodic, and used to treat dysentry and wounds (Brandis 1874; Burkill 1935). The limonoid, cedrelone, exhibits antifeedant properties against a variety of insects, e.g. inhibiting noctuid larval growth but is believed not to affect the insect's endocrine system [Koul & Isman, Entom. Exp. Appl. 64 (1992) 281].

Notes — 1. This is the most wide-ranging *Toona* species, which exhibits considerable variation in filament pubescence. It was first described from India, where it is the dominant *Toona* and is characterized by glabrous filaments. This variant extends eastwards to Hainan. Showing a more restricted distribution within this range, are plants with glabrescent or sparsely pilose/villous filaments, while extending the range as far as eastern Australia are plants with conspicuously villous filaments. Whether the eastern variants should be recognized infraspecifically has yet to be determined. *Cedrela velutina* is included here with some hesitation as it is based on a scrappy sterile specimen, which was included in *Chukrasia* by e.g. Hiern in Hook.f., Fl. Brit. India 1 (1875) 568.

2. The correct status of the following species has yet to be determined; it may be a good morphologically distinct species, or simply a large-fruited geographical variant of *Toona ciliata*.

3a. **Toona calantas** Merr. & Rolfe

Toona calantas Merr. & Rolfe, Philipp. J. Sc., Bot. 3 (1908) 105; Whitford, For. Philipp. 2 (1911) 45; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 357; Elmer, Leafl. Philipp. Bot. 9 (1937) 3388; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 344, t. 263.

Cedrela odorata Blanco, Fl. Filip., ed. 1 (1837) 184, non L.; Merr., Sp. Blanc. (1918) 31.

?*Cedrela inodora* Hassk., Hort. Bogor. 1 (1858) 131; Miq., Fl. Ind. Bat. 1, 2 (1859) 549; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 64; C.DC. in DC., Monogr. Phan. 1 (1878) 747. — ?*Surenus inodora* (Hassk.) Kuntze, Rev. Gen. Pl. 1 (1891) 111. — ?*Toona inodora* (Hassk.) Hochr. in Briq., Mém. Inst. Nat. Genev. 24 (1935) 32. — ?*Cedrela febrifuga* Blume var. *inodora* (Hassk.) C.DC., Rec. Bot. Surv. India 3 (1908) 373. — ?*Toona sureni* (Blume) Merr. var. *inodora* (Hassk.) Bahadur, Monogr. Toona (1988) 136, nom. illeg.

Toona paucijuga Merr., Philipp. J. Sc., Bot. 7 (1912) 279; Enum. Philipp. Flow. Pl. 2 (1923) 357; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46.

[?*Toona philippinensis* Elmer, Leafl. Philipp. Bot. 9 (1937) 3388, nom. non rite publ., anglice ('*philippinense*'); Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 46. — ?*Toona sureni* (Blume) Merr. var. *philippinensis* Bahadur, Monogr. Toona (1988) 138, nom. non rite publ., anglice ('*philippinense*').]

See Note 2 to the previous species.

This is an important timber tree in the Philippines, where it is commonly known as 'kalantas' or 'calantas'; it is reported to occur at low and medium altitudes in primary forests in the Batan Islands, Luzon, Mindoro, Samar, Negros, Leyte, Cebu and Mindanao.

Flowering specimens are rare, but the fruits are characterized by the following features: *Capsules* large, (20–)28–40 mm long; columella 24–40 mm long, 7–15 mm broad; valves dark red to red-brown, smooth, 24–41 by 4–14 mm, lenticellate with numerous lenticels (0.1–1 mm diam.), which are often smaller and denser towards the base of the capsule. *Seeds* (14–)20–32 by 3.2–6 mm, wings unequal with broadly obtuse apices; seed body 4.2–10 by 1.5–3 mm.

Specimens which might also belong to this taxon occur in Sumatra (Lampong), Peninsular Malaysia (Selangor, Pahang), Borneo (Sabah), Java (Madiun, Besuki), and New Guinea (Manokwari, Port Moresby, Manus Island).

Vernacular names — Philippines: anipla (Iv.); danigga (Ibn.); danigpa, danupra (Ilk.); kalantas (Pang., Tag.); kantingen (Ilk., Sbl.); lanigda, lanigpa (Bik.); lanipga (Bik., S.L. Bis., C. Bis); porak (Ilk.); Borneo (Sabah): via (Dusun); limpaga (Malay); melipaga (Dusun, Kwijau); surian; Malaya: serai wangi; Java: soeren (Sempol).

Uses — In addition to its timber value, bark decoctions are considered to have astringent and antiseptic properties, and are used to clean wounds or for gangrenous ulcers. Flower decoctions are also used as an antispasmodic [L.M. Perry, Medic. Pl. E & SE Asia (1980) 263].

Tribus Xylocarpeae

Xylocarpeae Blume, Bijdr. (1825) 178; Noamesi, Rev. Xylocarpeae, unpubl. thesis, Univ. Wisconsin (1958) 103; T.D. Penn. & Styles, Blumea 22 (1975) 524.
Carapeae Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 267, 276.

Trees. *Indumentum* of simple hairs. *Flowers* without a gynophore. *Petals* free. *Staminal tube* urceolate or cupular, margin lobed; anthers 8–10. *Capsule* ± woody or leathery with a rudimentary columella. *Seeds* unwinged, with a corky or woody outer layer; cotyledons large, united; endosperm absent.

Distribution — Two genera, tropics: *Carapa* (see Note 1 under *Xylocarpus*) and the following.

XYLOCARPUS

Xylocarpus Koen., Naturf. 20 (1784) 2; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 81; Noamesi, Rev. Xylocarpeae, unpubl. thesis, Univ. Wisconsin (1958) 103; T.D. Penn. & Styles, Blumea 22 (1975) 525; Mabb., Malays. For. 45 (1982) 448; Toml., Bot. Mangroves (1986) 274. — *Granatum* [Rumph., Herb. Amb. 3 (1743) 92, t. 61, 62, ex] Kuntze, Rev. Gen. Pl. 1 (1891) 110, p.p., nom. superfl., non St. Lag. (1880).
Carapa auctt., p.p., non Aubl.
Monosoma Griff., Notul. 4 (1854) 502.

Semi-evergreen maritime trees. *Twigs* lenticellate, cicatrose. *Leaves* paripinnate with (1–)2–4(–5) pairs of leaflets, entire, glabrous. *Flowers* unisexual in short axillary thyrses. *Calyx* 4-lobed to about the middle, valvate. *Petals* 4, contorted and much longer than the calyx in bud. *Staminal tube* margin with 8 suborbicular, retuse or shallowly and irregularly divided lobes; anthers 8, included. *Disk* cushion-shaped, beneath or surrounding and united with ovary, red. *Ovary* 4- (or 5-)locular, each locule with 3 or

4(–6) ovules; style short, stylehead discoid, its margin crenellate and its upper surface with four radiating stigmatic grooves. *Fruit* a large pendulous subspherical capsule, tardily dehiscing by 4 (5) leathery valves from apex. *Seeds* 5–20, large, irregularly tetrahedral or pyramidal, outermost surface convex, attached to central columella, with aerenchymatous (?sarcotestal) coat; embryo with the radicle lying above the hilum; germination cryptocotylar, the numerous subulate cataphylls verticillate or spirally arranged; true leaves simple, entire, later ones trifoliolate (rarely first ones thus). 2n = 52.

Distribution — Three species throughout the coastal regions of the Old World tropics from East Africa to the Western Pacific.

Habitat & Ecology — Mangrove swamps and coastal woodlands on rock and other substrates. The seeds float just below the surface of the sea and are widely dispersed in currents. *Xylocarpus* was one of the first genera of trees to colonize Krakatoa after its eruption in 1883 (Harms, 1940: 27). Although not truly viviparous, the embryos, like those of *Avicennia* and *Laguncularia*, are well developed when they fall and emerge as seedlings soon afterwards [White, Veg. Afr. (1983) 261]. Organic solutes contributing to the osmotic potential of the leaves of the two mangrove species include proline [Popp et al., Vegetatio 61 (1985) 247]. In the Sundarbuns of India, the nectar produced by the flowers is an important source for bees (*Apis dorsata*), which move to the forests from March to July, a migration of some hundreds of kilometres [Chakrabarti & Chaudhuri, Sci. Cult. 38 (1972) 269].

Uses — The wood of all three species is rich redbrown in colour and hard. When large enough pieces are available they are used for boat-building (still practised in the Maldives, where *X. rumphii* is largely used, Balasubramaniam) and construction as well as for good quality furniture, but the trees are often left in mangrove from which trees of other species have been removed for the production of charcoal. Details of the wood structure are provided by Panshin [Philipp. J. Sc. 48 (1932) 150] and T.D. Penn. & Styles (l.c.), where details of palynology are also presented.

The bark is used in tanning. Of the commercial tan barks in the Philippines Filamor [Philipp. J. Anim. Ind. 26 (1965) 43] reports that *Xylocarpus* has the highest percentage (13.13) tannin in the bark. With leather, it penetrates rapidly and gives a firm texture and a tan colouration. It gives cloth an umber or red colour. Mixed with the tanbark of *Ceriops*, fixed with potassium dichromate, and coaltar fixed with petrol, the bark ('nigi') has been found to be the most efficacious preservative for fishing nets in the Philippines [Bersamin et al., Philipp. J. Sc. 96 (1967) 143].

A number of medical uses have been gathered together by L.M. Perry [Med. Pl. E & SE Asia (1980) 263]: all parts of the plant are astringent, especially the roots and bark, which has been widely used in the treatment of dysentery. Plants have been raised in Florida [Gill, Bull. Fairchild Trop. Gard. 24, 3 (1969) 10].

Notes — 1. *Xylocarpus* is closely related to *Carapa* Aubl., a genus of the neotropics, west and central Africa, differing in its large inflorescences of flowers with imbricate sepals, its woody-coated seeds and leaves with 6–12(–18) pairs of leaflets and a dormant glandular (or rarely a fully developed) terminal leaflet, while 2n = 58. Neverthe-

less, the genera are closely allied, being geographical vicariants with differing ecology, for *Carapa* is a forest genus.

2. In view of the widespread nature of the three *Xylocarpus* species and because they have been widely confused (see Mabberley, l.c., for analysis) since the time of Rumphius, who first made a published description of the genus, only literature pertinent to Malesia is cited below.

3. A guide to the voluminous literature on the ecology, silviculture and uses of the genus throughout its range may be found under the index entries '*Carapa*' and '*Xylocarpus*' in B. Rollet, Bibliography on mangrove research 1600–1975, UNESCO (1981).

4. The species are most readily distinguished in the field and collectors have so far reported no intermediate specimens. In West Malesia, moreover, the local people have separate names for the two mangrove species which are frequently confused by herbarium workers. Indeed, in the absence of ecological information, ripe fruit, details of the bark, buttresses and pneumatophores, all of which are distinguishing field characters, the museum worker may well be at a loss to pigeon-hole specimens, particularly sterile material, and those from young plants may be almost impossible to determine. Noamesi (l.c.) has shown that the features of the staminal tube formerly used to distinguish species are unreliable but the pedicel character is a useful one. He further suggests that *X. moluccensis* ('*X. mekongensis*'), which is intermediate in many of its characteristics between the other two, may have arisen as an hybrid between them. Furthermore, it would be tempting to explain away the intermediate herbarium specimens as being derived from hybridizations or even continuing introgression, but, without critical field studies, sampling within and between trees, this would be an unwarranted speculation [see White, Mitt. Bot. Staatssamml. München 10 (1971) 107]. Furthermore, as the most frequently confused species, the mangrove-living *X. granatum* and *X. moluccensis* grow together, there is also the possibility for mixed gatherings.

KEY TO THE SPECIES

1a. Leaflets in 2–4 (5) pairs, ovate to cordate; pedicels not conspicuously swollen near calyx; fruit 6–8 cm diam.; tree of rocky coasts and sand, not mangrove, with neither conspicuous buttresses nor pneumatophores ..... **1. X. rumphii**

b. Leaflets in 1–3 (4) pairs, obovate to elliptic, apex rounded to obtuse; pedicels swollen or not; fruit 6–25 cm diam.; trees of mangrove and other muddy substrates with either conspicuous buttresses or pneumatophores 2

2a. Leaflets somewhat elliptic-ovate, not rounded at apex; thyrse 3–8(–13) cm long, usually with distinct main axis; pedicels not conspicuously swollen near calyx; fruit 6–11 cm diam.; buttresses not ribbon-like, pneumatophores erect, pointed ..... **2. X. moluccensis**

b. Leaflets usually rounded at apex, coriaceous; thyrse 1–6 cm long, often with distinct main axis; pedicels conspicuously swollen near calyx; fruit 12–25 cm diam.; buttresses flattened, ribbon-like spreading across mud, pneumatophores absent .. **3. X. granatum**

Fig. 56. *Xylocarpus rumphii* (Kostel.) Mabb. a. Flowering shoot; b. half flower; c. bark. — *X. moluccensis* (Lam.) M. Roem. d. Leaf; e. bark. Drawing R. Wise. Reproduced (rearranged) with permission from Tree Flora of Malaya 4.

1. **Xylocarpus rumphii** (Kostel.) Mabb.

Xylocarpus rumphii (Kostel.) Mabb., Malays. For. 45 (1982) 450; in Fl. Nouv.-Caléd. et Dép. 15 (1988) 81, t. 15, f. 1, 2; in Tree Fl. Malaya 4 (1989) 260, f. 12A. — *Carapa rumphii* Kostel., Allg. Med. Pharm. Fl. 5 (1836) 1988.

Carapa moluccensis auct. non Lam.: DC., Prodr. 1 (1824) 626, p.p.; Hiern in Hook. f., Fl. Brit. India 1 (1875) 567, p.p.; ?C.DC., Bot. Jahrb. 7 (1886) 461; in Engl., Bot. Ergebn. Gazelle (1890) 34; ?Warb., Bot. Jahrb. 13 (1891) 342; King, J. As. Soc. Beng. 64, ii (1895) 87, p.p.; Backer, Schoolfl. Java (1911) 217, excl. var. *elliptica* Koord. & Valeton.

Xylocarpus forstenii Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 62.

Amoora naumannii sensu C.DC. in Engl., Bot. Ergebn. Gazelle (1890) t. 10, non C.DC., Bot. Jahrb. 7 (1886) 461; cf. Mabb., Blumea 31 (1985) 131.

Aglaia zollingeri C.DC., Bull. Herb. Boiss. 2 (1894) 579; Backer, Schoolfl. Java (1911) 212; Koord., Exk. Fl. Java 2 (1912) 447; Backer & Bakh. f., Fl. Java 2 (1965) 127; cf. Mabb., Blumea 38 (1994) 309. — *Amoora zollingeri* (C.DC.) Koord., Exk. Fl. Java 2 (1912) 444.

Xylocarpus granatum auct. non Koen.: Pierre, Fl. For. Cochinch. (1897) t. 359A; Harms in K.Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 379; ?Briq., Mém. Inst. Nat. Genev. 24 (1935) 38; Elmer, Leafl. Philipp. Bot. 9 (1937) 3395.

Fig. 57. *Xylocarpus rumphii* (Kostel.) Mabb., flowering shoot (*Mabberley & Chan 1999*). West Malaysia, Port Dickson, July 1981. Photograph D.J. Mabberley.

Xylocarpus moluccensis auct. non M. Roem.: Merr., Interpr. Rumph. (1917) 307, p.p.; Enum. Philipp. Flow. Pl. 2 (1923) 358; Ridley, Kew Bull. (1938) 291; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 83, t. 19, f. D, G–M; Bot. Jahrb. 72 (1942) 158; Noamesi, Rev. Xylocarpeae, unpubl. thesis, Univ. Wisconsin (1958) 137; Backer & Bakh. f., Fl. Java 2 (1965) 118, p.p.; Johnstone, Biotropica 13 (1981) 254; Toml., Bot. Mangroves (1986) 282.

[*Granatum litoreum latifolium* Rumph., Herb. Amb. 3 (1743) 92, t. 62; Buc'Hoz, Hist. Univ. Veg. Pl. 1 (1773) t. [82].]

Tree 4–12(–18) m with neither conspicuous buttresses nor pneumatophores; bole usually solitary, to 50 cm diam., frequently of poor form. Bark lenticellate to finely fissured, greyish; inner bark bright pink to red. *Leaf* rachis and petiole to 22 cm with terminal spike to 1 mm. *Leaflets* in 2–4 pairs, 5–10(–16) by (2–)3–5(–9.5) cm, ovate to cordate, sometimes ± falcate, base broadly cuneate or rounded to truncate or cordate, asymmetric, apex acute to acuminate; venation prominent on both surfaces in sicco, conspicuous in vivo; petiolule (0–)1–3(–5) mm. *Thyrses* 10–18(–28) cm long, lax, pendent, main axis distinct; lateral branches to 8 cm; bracts and bracteoles c. 0.5 mm, narrowly triangular, persistent; pedicels 3–8 mm, not conspicuously swollen near calyx. *Calyx* lobes 1–1.5 mm long. *Petals* 3.5–6 by 2–2.5 mm, elliptic-oblong, creamy white. *Staminal tube* 2–2.5 mm diam., lobes apiculate or bifid to retuse. *Fruit* 6–8 cm diam., globose. *Seeds* 8–16, 3.6–7 cm long. First leaves compound (Turner). — **Fig. 56a–c, 57.**

Distribution — Old World tropics from East Africa to Tonga; throughout *Malesia* but so far unrecorded from the Bornean (or New Caledonian) mainland and rare in Sumatra.

Habitat — Cliffs and rocks near surf and sandy substrates above high watermark.

Vernacular names — Niri, nyireh (Malay Peninsula, Sumatra, Java); piagau (Philippines: Tag., P.Bis., Mag.); New Guinea: kabahai (Pom), tawihi (Misima), wadawada (New Britain).

2. **Xylocarpus moluccensis** (Lam.) M. Roem.

Xylocarpus moluccensis (Lam.) M. Roem., Synops. Monogr. 1 (1846) 124; Merr., Interpr. Rumph. (1917) 307, p.p.; J. Str. Br. Roy. As. Soc., spec. no. (1921) 318; Beck., Tectona 15 (1922) 581, t. 34, f. 7; Craib, Fl. Siam. Enum. 1 (1926) 265, quoad var. *gangeticus* (Prain) Craib; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) 84, incl. var. *ellipticus* (Koord. & Valeton) Harms; Merr., Pl. Life Pac. World (1946) 31; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 888, ?p.p.; Backer & Bakh. f., Fl. Java 2 (1965) 118, p.p.; Mabb., Malays. For. 45 (1982) 450; Sant., Nat. Hist. Bull. Siam Soc. 31 (1983) 78; Mabb. in Tree Fl. Malaya 4 (1989) 260, f. 12C. — *Carapa moluccensis* Lam., Encycl. Méth. 1 (1785) 621; Pers., Syn. 1 (1805) 416; Wood in Rees, Cyclop. 6, 2 (1806) Carapa n. 2; G. Don, Gen. Syst. 1 (1831) 686; Span., Linnaea 15 (1841) 183, p.p.; Schimper, Indomal. Strandfl. (1891) 99; Karst., Bibl. Bot. 5, 22 (1891) 21, 23, 51, t. 6, f. 58–63, t. 8, f. 119–123, t. 11, f. 142; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 193, incl. var. *elliptica*; Koord., Minah. (1898) 384; Prain, Rec. Bot. Surv. India 2 (1903) 292, incl. var. *gangetica* Prain & var. *ovalifolia* Koord. ex Prain; Backer, Fl. Batavia (1907) 282, incl. var. *elliptica*; ?C.DC., Nova Guinea, Bot. 8 (1910) 426, incl. var. *elliptica*; Backer, Schoolfl. Java (1911) 217, quoad var. *elliptica*; Brown & Fisher, Bull. Philipp. Dep. Agr. Bur. For. 17 (1918) 32, t. 12 & 22 (1920) t. 12; Ridley, Fl. Malay Penins. 1 (1922) 414, p.p.; Groom & Wils., Ann. Bot. 39 (1925) 9, t. 8; Watson, Mal. For. Rec. 6 (1928) 70, 124, 184, 187, t. 34, 35; ?Burkill, Dict. Econ. Prod. Malay Penins. (1935) 455; Corner, Wayside Trees 1 (1940) 459; Blake, Austral. J. Bot. 2 (1954) 121; Corner, Wayside Trees, ed. 3 (1988) 498. — *Granatum moluccensis* (Lam.) Kuntze, Rev. Gen. Pl. 1 (1891) 110.

Xylocarpus granatum auct. non Koen.: Sm. in Rees, Cyclop. 39, 1 (1818) Xylocarpus n. 1, p.p.; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 244, t. 20, f. 22, p.p.; Miq., Fl. Ind. Bat. 1, 2 (1859) 546, p.p.; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 62, p.p.; Schmidt, Bot. Tidsskr. 26 (1904) 68; Veg.-Bild. 3 (1906) t. 40; Whitford, For. Philipp. 2 (1911) 48; Koord., Exk. Fl. Java 2 (1912) 437, p.p.; Ridley, Kew Bull. (1938) 288.

Carapa obovata auct. non Blume: King, J. As. Soc. Beng. 64, ii (1895) 87, p.p.; Pellegr. in Fl. Indo-Chine, Suppl. (1946) 719, quoad var. *microphylla* (Pierre) Pellegr.; Ridley, Fl. Malay Penins. 1 (1922) 414, p.p.

Xylocarpus mekongensis Pierre, Fl. For. Cochinch. 5 (1897) t. 359B; Noamesi, Rev. Xylocarpeae, unpubl. thesis, Univ. Wisconsin (1958) 124; Johnstone, Biotropica 13 (1981) 253, t. 1, 254; Toml., Bot. Mangroves (1986) 281, f. 5.7, B40, 41. — *Carapa mekongensis* (Pierre) Pellegr., Fl. Indo-Chine 1 (1911) 777.

Xylocarpus obovatus auct. non A. Juss.: Pierre, Fl. For. Cochinch. 5 (1897) sub t. 358, quoad var. *microphyllus* Pierre.

Carapa borneensis Becc., For. Born. (1902) 574.

Xylocarpus gangeticus (Prain) C.E. Parkinson, Ind. For. 60 (1934) 140, t. 17.

Xylocarpus australasicus Ridley, Kew Bull. (1938) 291; Johnstone, Biotropica 13 (1981) 254.

Xylocarpus parvifolius Ridley, Kew Bull. (1938) 291.

[*Granatum litoreum parvifolium* Rumph., Herb. Amb. 3 (1743), quoad t. 61; Buc'Hoz, Hist. Univ. Veg. Pl. 6 (1775) t. [24].]

Tree 6–18(–30, Watson) m, with small buttresses and many pointed pneumatophores; bole usually solitary, to 70(–210, Watson) cm diam. Bark rough with longitudinal fissures, falling as oblong flakes. *Leaf* rachis and petiole to 10 cm, sometimes

Fig. 58. *Xylocarpus moluccensis* (Lam.) M. Roem. Base of sapling tree with pneumatophores. Silt bank near Pasuruan, E Java. Photograph J. Jeswiet, 1916.

with persistent apical spike to 1 mm. *Leaflets* in (1) 2 or 3 (4) pairs, (5–)7–10(–17) by (2.5–)4–6.5(–7) cm, elliptic-oblong or lanceolate to oblanceolate, base cuneate, ± asymmetric, apex acute to obtuse, venation prominent on both surfaces in sicco; petiolule (0–)2–5 mm, sometimes swollen. *Thyrses* 3–8(–13) cm long, often produced with the new leaves, ± lax, main axis clear; lateral branches to 4 cm; bracts and bracteoles c. 0.5 mm, ± persistent; pedicels 3–8 mm, not conspicuously swollen near calyx. *Calyx* lobes 1–1.7 mm long. *Petals* 3.5–4 by 2–3 mm, oblong to obovate, creamy white. *Staminal tube* 2–3 mm diam., lobes acute to apiculate or bifid to retuse. *Fruit* 6–11 cm diam., flattened-globose. *Seeds* 5–10, 4–6.5 cm long. First leaves simple. — **Fig. 56d, e, 58.**

Distribution — Tropical Asia from India (Sundarbans), Indochina and Thailand throughout *Malesia* to tropical Australia. The underlying ecological explanation for the restriction of *X. moluccensis* within Indomalesia (cf. the other species) is unknown, but it may be that it is less tolerant of seasonality than are the other two.

Habitat — Mangrove swamps, most commonly in the upper reaches, often in only slightly brackish water (Corner, l.c.).

Vernacular names — Nyireh batu (Malay Peninsula, Sumatra, Java); New Guinea: bubaia (Kinomeri), jasoguago (Wanigela), kabaju (Hattam), pihsih (Roro), teteliat (Tehid), uburi (Goaribari).

Notes — 1. This species has been widely confused with the next, the first clear distinction being made by Beccari (l.c.).

2. The names of *Xylocarpus* species hinge on an interpretation of Rumphius's plates in Herbarium Amboinense. His tab. 62 is clearly *X. rumphii* and the material figured in tab. 61 is referable to mangrove plants (Mabberley, l.c.). I have interpreted the plate as *X. moluccensis*, but, should the two branches depicted there ever be shown to represent both this species and *X. granatum*, it would be wise, in the interests of nomenclatural stability, to designate the smaller of them, the one which most closely resembles both Lamarck's brief description and the plant here, as lectotype.

3. **Xylocarpus granatum** Koen.

Xylocarpus granatum Koen., Naturf. 20 (1784) 2; Willd., Sp. Pl. 2 (1799) 328; Poir. in Lam., Encycl. Méth. 8 (1808) 806; Sm. in Rees, Cyclop. 39, 1 (1818) Xylocarpus n. 1, p.p.; A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 244, t. 20 f. 22, p.p.; Blanco, Fl. Filip. (1837) 298; ed. 2 (1845) 207 ('*Xilocarpus*'); M. Roem., Synops. Monogr. 1 (1846) 124; Miq., Fl. Ind. Bat. 1, 2 (1859) 546, p.p.; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 62, p.p.; Blanco, Fl. Filip., ed. 3, 2 (1878) 24; Merr., Interpr. Rumph. (1917) 306; Sp. Blanc. (1918) 208; Brown & Fisher, Bull. Philipp. Dept. Agr. Bur. For. 17 (1918) 30, t. 11; 22 (1920) 30, t. 11; Merr., J. Str. Br. Roy. As. Soc., spec. no. (1921) 318; Enum. Philipp. Flow. Pl. 2 (1923) 358; Beck., Tectona 15 (1922) 580, t. 34 f. 6; Lane-Poole, For. Res. Papua New Guinea (1925) 103; Merr., Univ. Calif. Publ. Bot. 15 (1929) 120; Ogura, Bot. Mag. Tokyo 54 (1940) 395, cum tab.; Harms in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 19b1 (1940) t. 19 A–C (?E, F); Bot. Jahrb. 72 (1942) 158; Merr., Pl. Life Pacif. World (1946) 52, t. 56; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 887; Quisumb., Med. Pl. Philipp. (1951) 489; Noamesi, Rev. Xylocarpeae, unpubl. thesis, Univ. Wisconsin (1958) 107; Backer & Bakh. f., Fl. Java 2 (1965) 118; T.D. Penn. & Styles, Blumea 22 (1975) 514, fig. g, h; Mabb., Malays. For. 45 (1982) 450; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 346, t. 265; Toml., Bot. Mangroves (1986) 278, figs. B.39, 42, 43; Mabb. in Fl. Nouv.-Caléd. et Dép. 15 (1988) 82, t. 15 f. 3, 4;

in Tree Fl. Malaya 4 (1989) 260, f. 12B. — *Carapa granatum* (Koen.) Alston in Trim., Handb. Fl. Ceylon 6 (1931) 45 (*'granata'*); Burkill, Dict. Econ. Prod. Malay Penins. (1935) 452; Corner, Wayside Trees 1 (1940) 458; Life Pl. (1964) t. 36C; Wayside Trees, ed. 3 (1988) 497. — *Carapa indica* A. Juss. in Cuv., Dict. Sci. Nat. 7 (1817) 32, nom. superfl.

Carapa moluccensis auct. non Lam.: DC., Prodr. 1 (1824) 626, p.p.; Hiern in Hook. f., Fl. Brit. India 1 (1875) 567, p.p.; Fern.-Vill., Nov. App. (1880) 44; Vidal, Sin. Atl. (1883) xx, t. xxix, f. F; King, J. As. Soc. Beng. 64, ii (1895) 87, p.p.; Kamerl., Teysmannia 22 (1911) 118, 129, cum tab.; Backer, Schoolfl. Java (1911) 217, quoad var. *typica* Backer; Ridley, Fl. Malay Penins. 1 (1922) 414, p.p.

Carapa obovata Blume, Bijdr. (1825) 179; C.DC. in DC., Monogr. Phan. 1 (1878) 718; Schimper, Indomal. Strandfl. (1891) 99, t. 7 f. 1; King, J. As. Soc. Beng. 64, ii (1895) 87, p.p.; Koord. & Valeton, Bijdr. Booms. Java 3 (1896) 189; Koord., Minah. (1898) 384; Becc., For. Born. (1902) 574; Backer, Fl. Batavia 1 (1907) 280; Schoolfl. Java (1911) 217; Ridley, Fl. Malay Penins. 1 (1922) 414, p.p.; Watson, Mal. For. Rec. 6 (1928) 70, 124, 184, 187, t. 36, 37. — *Xylocarpus obovatus* (Blume) A. Juss., Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 244; M. Roem., Synops. Monogr. 1 (1846) 124; Miq., Fl. Ind. Bat. 1, 2 (1859) 546; Suppl. (1861) 197; Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 62; Harms in Engl. & Prantl, Nat. Pflanzenfam. 3, 4 (1896) t. 157, f. A–C; Pierre, Fl. For. Cochinch. 5 (1897) sub t. 358, incl. var. *macrophyllus* Pierre; Harms in K. Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 379; Merr., Bull. Philipp. Bur. For. 1 (1903) 28; Perkins, Fragm. Fl. Philipp. (1904) 30; Whitford, For. Philipp. 2 (1911) 47; Koord., Exk. Fl. Java 2 (1912) 437. — *Granatum obovatum* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 110.

?*Xylocarpus carnulosus* Zoll. & Mor., Nat. Gen. Arch. Neerl. Ind. 2 (1845) 582; Miq., Fl. Ind. Bat. 1, 2 (1859) 546. — ?*Carapa carnulosa* (Zoll. & Mor.) Kurz, J. As. Soc. Beng. 39, ii (1870) 72 (*'carnosa'*); Prelim. Rep. Veg. Pegu App. A (1875) xxxiii.

Monosoma littorata Griff., Notul. 4 (1854) 502; Ic. 4 (1854) t. 588, f. 3.

?*Guarea oblongifolia* Griff., Notul. 4 (1854) 503.

?*Amoora salomoniensis* C.DC., Bot. Jahrb. 7 (1886) 461; in Engl., Bot. Ergebn. Gazelle (1890) 33.

Xylocarpus benadirensis Mattei, Boll. Ort. Bot. Palermo 7 (1908) 99.

Xylocarpus moluccensis auct. non M. Roem.: Schimper & Faber, Pflanzengeogr., ed. 3 (1935) 140, t. 34.

Xylocarpus minor Ridley, Kew Bull. (1938) 289.

[*Granatum litoreum parvifolium* Rumph., Herb. Amb. 3 (1743) 93, non t. 61 (= *X. moluccensis*).]

Tree or shrub (1–)6–15(–20) m with thin, branched, ribbon-like buttresses spreading out from base; bole solitary or occasionally more, to 90(–180, Watson) cm diam., often of poor form. Bark thin, smooth, scaling as irregular flakes, whitish to yellow-brown; inner bark reddish or pink. *Leaf* rachis and petiole to 9(–12) cm, usually much less. *Leaflets* in 1 or 2 (3) pairs, (3.5–)5–12 by (2–)3–6 cm, coriaceous, obovate or elliptic, base cuneate, apex rounded or obtuse, venation prominent on both surfaces in sicco, petiolules (2–)5–6(–11) mm, swollen. *Thyrses* (1–)3–6 cm, ± squarrose, borne on new and older twigs, frequently ± forked with indistinct main axis; bracts and bracteoles c. 0.5 mm, caducous; pedicels 3–9 mm, conspicuously swollen towards the calyx. *Calyx* lobes 1–3 mm long. *Petals* 3.5–5.5(–6.5) by 2–3 mm, oblong, creamy white or pinkish. *Staminal tube* 2–3.5 mm diam., lobes apiculate or bifid to retuse. *Fruit* 12–25 cm diam., flattened-globose. *Seeds* 8–16(–20), 4–6 cm long. First leaves simple. — **Fig. 59, 60.**

Distribution — Old World tropics from East Africa and continental Asia throughout *Malesia* to Tonga.

Habitat — Mangroves, usually estuarine and often associated with *Nypa* and *Sonneratia*.

Vernacular names — Nyireh bunga (Malay Peninsula, Sumatra, Java); Philippines: bigi (Tagk.), tabigi (Tag., Bik., Tagb., P.Bis., S.L.Bis., C.Bis., Lan., Sul., Mag., official common name); New Guinea; awol (New Britain), ecahi (Labu), kaav (Bian), mokkemoffe (Arguni).

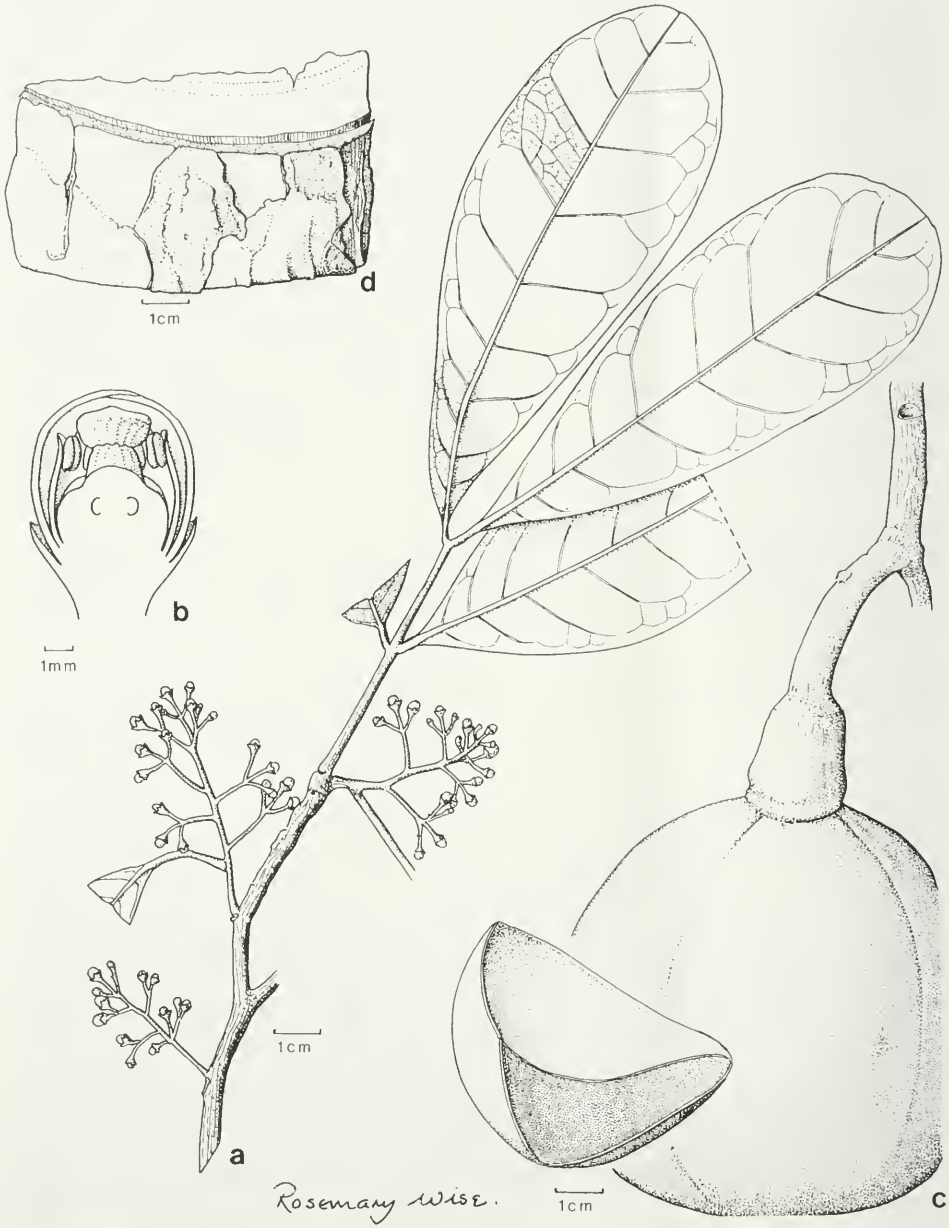

Fig. 59. *Xylocarpus granatum* Koen. a. Flowering shoot; b. half flower; c. unripe fruit and seed; d. bark. Drawing R. Wise. Reproduced (rearranged) with permission from Tree Flora of Malaya 4.

Fig. 60. *Xylocarpus granatum* Koen. Base of tree with snake roots, Dr. R.E. Holttum standing next to the tree. Mangrove near Cilacap, Central Java. Photograph J. Jeswiet, 1929.

Fig. 61. *Aglaia odorata* Lour. Male inflorescence. Campus Universiti Malaya, Kuala Lumpur. Photograph C.M. Pannell, 1978.

CULTIVATED SPECIES

Besides *Aglaia korthalsii*, *Lansium domesticum*, *Melia azedarach*, *Azadirachta indica*, and *Sandoricum koetjape*, considered above under the respective genera, cultivated *Meliaceae* are largely neotropical and mostly grown for timber or as street-trees. See also the paragraph 'Uses' at the beginning of the family account. See Pennington & Styles in Fl. Neotropica 28 (1981) for full descriptions and synonymy of the neotropical species.

Aglaia odorata Lour.: Burkill, Dict. Econ. Prod. Malay Penins. (1935) 74; Pannell, Kew Bull., Add. Ser. 16 (1992) 298.

Bush or sometimes tree to 10 m. *Indumentum* of yellowish-brown stellate scales, especially dense on shoot apex and fruit surface. *Leaves* imparipinnate, 1- or 2- (or 3-) jugate, rachis sometimes narrowly winged. *Inflorescence* with widely spaced, yellow, fragrant flowers. *Fruits* obovoid, c. 1 by 0.7 cm, red, brown or orange. — **Fig. 61.**

Continental SE Asia. Commonly cultivated for its ornamental value, male trees more often than females. Strongly perfumed flowers used for scenting tea or clothes.

Carapa guianensis Aubl.: Corner, Wayside Trees 1 (1940) 458 ('*guyanensis*') & ed. 3, 2 (1988) 497.

Deciduous or semi-evergreen tree to 55 m in wild, flushing claret. *Leaves* paripinnate, usually 4–8-jugate. *Flowers* creamy white in thyrses to 60 cm long. *Fruit* 5–10 cm diam. *Seeds* with woody sarcotesta.

Tropical America. Source of valuable timber (crabwood) and oil (andiroba) and insecticide. Grown in Singapore. Fruits of *C. guianensis* from America have been washed up in the Carolines [Gunn & Dennis, Castanea 37 (1972) 199].

Carapa procera DC. from tropical America and Africa, with more rounded leaflets than in the previous species, has been cultivated in Java.

Cedrela odorata L. (including *C. mexicana* M.Roem., *C. glaziovii* C.DC.): Backer, Schoolfl. Java (1911) 218; Corner, Wayside Trees 1 (1940) 495; 2 (1940) t. 134, 135; ed. 3 (1988) 498, t. 146, 147.

Deciduous tree to 35(–60) m in wild. *Leaves* usually paripinnate, usually (5) 6–12 (–15)-jugate. *Flowers* creamy white, disagreeably scented, in thyrses to 40(–50) cm long. *Stamens* 5, free. *Capsule* with broadly 5-winged columella. *Seeds* 2–3 cm long, winged at one end.

Tropical America. Source of a valuable timber (cedar); planted throughout the tropics. Malay Peninsula, Java, Philippines, New Guinea.

Swietenia macrophylla King: Corner, Wayside Trees 1 (1940) 469; 2 (1940) t. 142; ed. 3 (1988) 507, t. 154; Backer & Bakh. f., Fl. Java 2 (1965) 118; Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 343, t. 262; Prawirohatmadjo et al. in Soeriane-

gara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 447, cum tab. — *Swietenia mahagoni* (L.) Jacq. var. *macrophylla* (King) Veitch, Travel Notes (1896) 53.

Deciduous tree to 40(–60) m. *Leaves* usually paripinnate, (2) 3–6(–8)-jugate. *Leaflets* c. 15 cm long. *Flowers* pinkish or white in thyrses to 18(–20) cm long. *Staminal tube* 10-lobed; anthers 10. *Capsule* to 15 cm long. *Seeds* to 10 cm long, winged at one end.

Tropical America. Introduced to Java in 1872 [see H. A. Fattah, Mahogany Forestry in Indonesia, in G. Hartshorn, Mahogany Workshop (1992)] and to Singapore in 1876 and by the 1930s widely planted there [Gard. Bull. Sing. 37 (1978) 114]; Malay Peninsula, Borneo, Java, Philippines. The trees bear a rich epiphytic flora [Johnson & Barkat Awan, Malays. For. 35 (1972) 5] and are more resistant to shoot-borers than is *S. mahagoni*. Plants have been raised through tissue culture [Lee & Rao, Gard. Bull. Sing. 41 (1988) 11].

Swietenia mahagoni (L.) Jacq.: Corner, Wayside Trees 1 (1940) 463 ('*mahogani*'); ed. 3 (1988) 508; Backer & Bakh. f., Fl. Java 2 (1965) 118; Prawirohatmadjo et al. in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 447, cum tab.

Tropical America. Similar to *S. macrophylla* but leaves 2–4-jugate, leaflets c. 3.5 cm long; thyrse to 5 cm; fruit smaller.

Singapore, Java, Philippines, Lesser Sunda Islands (Flores, Sumbawa).

DUBIOUS SPECIES

Aglaia allocotantha Harms, Bot. Jahrb. 72 (1942) 175; Pannell, Kew Bull., Add. Ser. 16 (1992) 350. — Type destroyed (New Guinea).

Aglaia araeantha Harms, op. cit. 162; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia bergmannii Warb., Bot. Jahrb. 8 (1891) 346; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia caroli Harms, Bot. Jahrb. 72 (1942) 176; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia everettii Merr., Philipp. J. Sc., Bot. 4 (1909) 271; Pannell, l.c. — Types destroyed (Philippines).

Aglaia gracillima Harms, Bot. Jahrb. 72 (1942) 171; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia hiernii Koord., Minah. (1898) 381, nom. nud.; Pannell, op. cit. 351. — Type not seen.

Aglaia huberti Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 472; Pannell, l.c. — Type destroyed (Borneo).

Aglaia koordersii Jain & Bennet, Ind. J. For. 9 (1987) 271, nom. nud.; Pannell, l.c. — Type not seen.

Aglaia ledermannii Harms, Bot. Jahrb. 72 (1942) 165; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia leptoclada Harms, op.cit. 166; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia maboroana Harms, op.cit. 173; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia phaeogyna Harms, op.cit. 167; Pannell, l.c. — Types destroyed (New Guinea).

Aglaia pycnoneura Harms, op.cit. 179; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia rodatzii Harms in K.Schum. & Laut., Fl. Deutsch. Schutzgeb. Südsee (1900) 386; Pannell, l.c. — Types destroyed (New Guinea).

Aglaia schraderiana Harms, Bot. Jahrb. 72 (1942) 168; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia schultzei Harms, op.cit. 177; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia spaniantha Harms, op.cit. 168; Pannell, op.cit. 352. — Types destroyed (New Guinea).

Aglaia steinii Harms, op.cit. 178; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia trichostoma Harms, op.cit. 169; Pannell, l.c. — Type destroyed (New Guinea).

Aglaia urophylla Harms, op.cit. 174; Pannell, l.c. — Types destroyed (New Guinea).

Aglaia vilamilii Merr., Philipp. J. Sc. 15 (1915) 536; Pannell, l.c. — Type destroyed (Philippines).

Aglaia vulpina Harms, Bot. Jahrb. 72 (1942) 175; Pannell, l.c. — Type destroyed (New Guinea).

Amoora naumannii C.DC., Bot. Jahrb. 7 (1886) 461 = ?**Dysoxylum sp.** See Mabb., Blumea 31 (1985) 131.

Boswellia ? integra Blanco, Fl. Filip., ed. 2 (1845) 242; ed. 3, 2 (1878) 86 = ?**Dysoxylum**. See Merr., Sp. Blanc. (1918) 210; Enum. Philipp. Flow. Pl. 2 (1923) 366.

Boswellia ? obliqua Blanco, op. cit. 243, 87 = ?**Dysoxylum**. See Merr., Sp. Blanc. (1918) 210; Enum. Philipp. Flow. Pl. 2 (1923) 366.

Dysoxylum microcricum Harms, Notizbl. Bot. Gart. Berlin 15 (1941) 477 = **Dysoxylum sp.** (sect. *Cyrtochiton*) — ?Type destroyed (New Guinea). The description suggests a relationship with the *D. cyrtobotryum* group.

Lachanodendron album Reinw. ex Blume, Cat. Gew. Buitenzorg (1823) 70, nom. nud. = **?**. See Mabb., Blumea 31 (1985) 140.

Lansium montanum Jack ex Spreng., Syst. 3 (1826) 66 = ?**Aglaia sp.** See Mabb., Blumea 31 (1985) 143.

Milnea montana [Jack, Trans. Linn. Soc. 14 (1823) 118, nom. provis.] (Spreng.) Steud., Nomencl., ed. 2, 1 (1841) 142; Miq., Fl. Ind. Bat. 1, 2 (1859) 544 = ?**Aglaia sp.** See Mabb., Blumea 31 (1985) 145.

Selbya montana (Spreng.) M. Roem., Synops. Monogr. 1 (1846) 126 = ?**Aglaia sp.** See Mabb., Blumea 31 (1985) 143.

EXCLUDED SPECIES

Aglaia chartacea Kosterm., Reinwardtia 7 (1966) 261 = **Lepisanthes tetraphylla** (Vahl) Radlk. (*Sapindaceae*). See Mabb., Blumea 31 (1985) 143.

Aglaia iloilo (Blanco) Merr., Philipp. J. Sc., Bot. 9 (1914) 533; Sp. Blanc. (1918) 212; Enum. Philipp. Flow. Pl. 2 (1923) 375; all excl. specim. cit. (= *Aglaia argentea* Blume). See Pannell, Kew Bull., Add. Ser. 16 (1992) 354, and also under *Melia iloilo* below.

Aglaia intricatoreticulata Kosterm., Reinwardtia 7 (1966) 259, t. 12 = ?**Lansium domesticum** Corr. (q.v.) or = ?**Lepisanthes** (*Sapindaceae*). See Mabb., Blumea 31 (1985) 140, 142.

Aglaia nivea Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 375, in syn. *Aglaia iloilo*. See Pannell, Kew Bull., Add. Ser. 16 (1992) 354, and under *Melia iloila* below.

Aglaia pinnata (L.) Druce, Rep. Bot. Exch. Club Brit. Is. 1913, 3 (1914) 413 = **Vitex pinnata** L. (*Labiatae–Viticoideae*).

Alliaria dasyphylla (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 109 = **Ailanthus integrifolia** Lam. (*Simaroubaceae*).

Alliaria euneuron (Miq.) Kuntze, l.c., see below under *Dysoxylum euneuron*.

Amoora aphanamixis auct. non J.A. & J.H. Schultes: Miq., Fl. Ind. Bat., Suppl. (1861) 196 = **Santiria griffithii** (Hook.f.) Engl. (*Burseraceae*). See Leenh. & Kalkm. in Fl. Males. I, 6 (1972) 921.

Amoora decandra (Wall.) Hiern (i.e. *Sphaerosacme decandra* (Wall.) T.D. Penn. from Himalaya), recorded in error from Malay Peninsula by Ridley, Fl. Malay Penins. 1 (1922) 400.

Amoora forbesii S. Moore, J. Bot. Lond. 64, Suppl. (1926) 4 = **Santiria apiculata** Benn. (*Burseraceae*). See Mabb., Blumea 38 (1994) 309.

Amoora roxburghiana Korth. ex Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 211, nom. in syn. = **Santiria laevigata** Blume (*Burseraceae*).

Amoora tomentosa Korth. ex Blume, l.c. = **Santiria tomentosa** Blume (*Burseraceae*).

Antelaea canescens Cels ex Heynh., Nom. Bot. Hort. 1 (1840) 315; Nomencl. Alph. (1846/7) 38, i.e. sphalm. pro *Anthelia ('Anthelea') canescens* Cels; see Cels, Cat. Cult. Cels Prix Cour. 1842 (1842) 8 = ?**Epipremnum sp.** (*Araceae*).

Azadirachta digyna Anon., Rév. Bot. Appl., Actes 8 (1928) 211, nom. nud. = ?

Cedrela taratara Blanco, Fl. Filip., ed. 2 (1845) 131; ed. 3, 1 (1877) 234 = mixtum. Teste Merr., Sp. Blanc. (1918) 213; Enum. Philipp. Flow. Pl. 2 (1923) 358, perhaps **Pterocarpus** (*Leguminosae*) wood with **Dysoxylum** or **Aglaia** herbarium material.

Dysoxylum dasyphyllum Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 19; C.DC. in DC., Monogr. Phan. 1 (1878) 526 = **Ailanthus integrifolia** Lam. (*Simaroubaceae*). See Koord., Minah. (1891) 374; Noot. in Fl. Males. I, 6 (1962) 218.

Dysoxylum euneuron Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 22; C.DC. in DC., Monogr. Phan. 1 (1878) 516. — *Alliaria euneuron* (Miq.) Kuntze = **Euphorianthus euneurus** (Miq.) Leenh. (*Sapindaceae*). See Leenh. in Fl. Males. I, 11 (1994) 536.

Flindersia R. Br. Now removed to *Rutaceae* (*Flindersiaceae*).

Harpagonia Noronha, Verh. Batav. Gen., ed. 5, 1 (1790/1) art. 4, 2, nom. nud. = **Psychotria** L. (*Rubiaceae*). See Steenis, Regn. Veget. 7 (1970) 375.

Melia iloilo Blanco, Fl. Filip., ed. 2 (1845) 241 = ?**Rutaceae**.

The plant described has opposite winged leaves which does not fit *Aglaia* to which Merrill referred it as *Aglaia iloilo* (Blanco) Merr. (see above). Although the vernacular name iloilo is found on herbarium material of *Aphanamixis polystachya* (Wall.) R. Parker, the description does not match *Aphanamixis* either and the combination of features strongly suggests *Rutaceae*, perhaps (Van Balgooy, pers. comm.) *Evodia*.

Owenia cerasifera F. Muell., Hook. J. Bot. 9 (1857) 305; Barr & Sug., Descr. Price List 1868 (1868) 6; Koch, Wochenschr. 11 (1868) 157; Robinson, Glean. Fr. Gard., ed. 2 (1869) 30; Forbes, Nat. Wand. (1885) 354; Hemsl., Bot. Chall. 1, 3 (1885) 132; Dyer, J. Linn. Soc., Bot. 21 (1885) 373, 374 ('*cerasifolia*'); Boerl., Handl. 1 (1890) 671 = **Pleiogynium timoriense** (DC.) Leenh. (*Anacardiaceae*). See Ding Hou in Fl. Males. I, 8 (1978) 474.

Pistaciovitex L. ex Kuntze in T. Post & Kuntze, Lex. Gen. Phan. (1903) 442, excl. syn. *Aglaia* = **Vitex** L. (*Labiatae–Viticoideae*).

The confusion derives from Burman's giving a plate of *Aglaia odorata* Lour. the name *Vitex pinnata*.

Pistaciovitex pinnata (L.) Kuntze, l.c., excl. syn. *Aglaia odorata* Lour. = **Vitex pinnata** L. (*Labiatae–Viticoideae*).

Trichilia volubilis Blanco, Fl. Filip., ed. 2 (1845) 249; ed. 3, 2 (1878) 98 = mixtum (largely *Leguminosae*). See C.DC. in DC., Monogr. Phan. 1 (1878) 751; Merr., Sp. Blanc. (1918) 194; Enum. Philipp. Flow. Pl. 2 (1923) 380.

Turraea trichostylis Miq., Fl. Ind. Bat., Suppl. (1861) 195, 502 = **Leptonychia caudata** (G. Don) Burret (*Sterculiaceae*). See Veldk. & Flipphi, Blumea 32 (1987) 451.

Walsura villosa auct. non Wall. ex Kurz: Ridley, Fl. Malay Penins. 1 (1922) 412 = **Harpullia cupanioides** Roxb. (*Sapindaceae*). See Leenh. & Vente, Blumea 28 (1982) 27.

Xylocarpus echinatus Calc. Cat. Exhib. 1862 ex Balf., Timb. trees E & S As., ed. 2 (1862) 268 & Cycl. India, ed. 2, 5 (1873) 221 = **Artocarpus sp.** (*Moraceae*).

Watson, Descr. Cat. Ind. Dept. Int. Exhib. 1862 (1862) 161, has *X. granatum* followed by *Artocarpus echinatus* Roxb. of which *X. echinatus* is clearly a 'portmanteau' or even a new combination! Compare *Lachanodendron domesticum* under *Lansium domesticum*.

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